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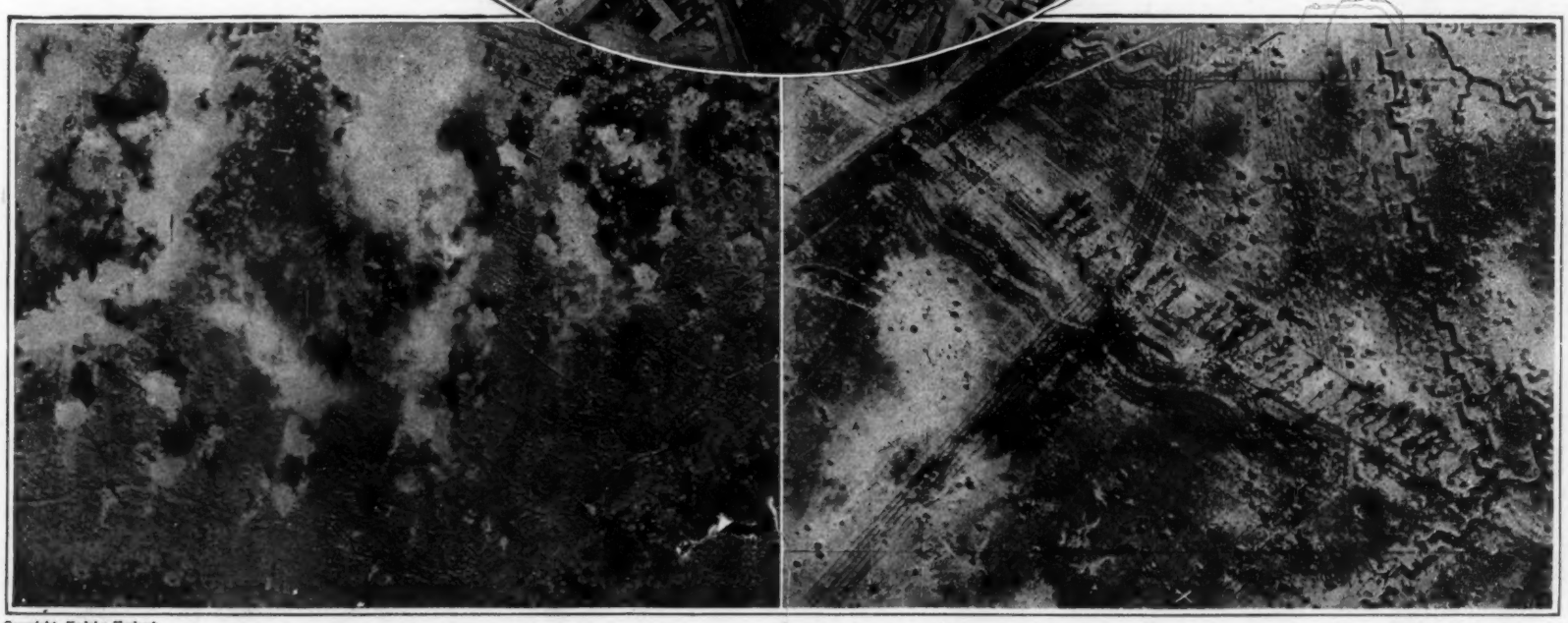
The Photographic Eye and Memory of the Military Airman

IT is difficult to conceive of a photographic plate that holds the fate of hundreds or thousands of men, batteries of guns, and possibly the decision of a great battle, in its thin coating of emulsion. Yet there are numerous such plates made every day by intrepid airmen, which, after being developed in less than fifteen minutes after reaching the ground and then flashed on the stereopticon screen in the presence of skilled photograph readers and officers, sign the death warrant of numerous soldiers and the order for the destruction of extensive military works and equipment, so to speak. In truth, the photographic plate is the eye and the memory of the military airman; and many a spirited combat among the clouds has for its sole object the preventing of a camera-plane from getting back to its airdrome with the all-important photographic information.

After viewing the original photographs from which the accompanying illustrations were copied, one no longer questions the vital importance of aerial photographs in military operations. Indeed, these photographs, which formed part of the collection of an Australian officer who passed through New York city on his way back to Australia to teach aerial reconnaissance, are perhaps the best specimens of aerial photography yet brought to this country and made public.

(Concluded on page 76)



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What the airman sees when flying over battlefields and back areas of France

In the order shown, the views are as follows: The cross roads of Zonnebeke before the British bombardment. The same cross roads after a two-day bombardment by British artillery. The center illustration shows the town of St. Pol, photographed at a height of 15,000 feet. The next view depicts a British barrage fire, cutting off the German front-line trenches during a British attack. The last illustration shows a portion of the famous Von Hindenburg line, with its extensive barbed-wire belts and elaborate trenches.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A No-Decision War

IT is difficult to get at the "German mind." Apparently there is a Kaiser mind and a Kuehlmann mind. One day the Kaiser tells the German people that he is going to give them a speedy victory by the sword and the next day comes his Foreign Minister, who says: "In view of the magnitude of this war and the number of powers, including those from overseas, that are engaged, its end can hardly be expected through purely military decisions alone, and without recourse to diplomatic negotiations." The "powers engaged" were never more resolute than now for a decision by force of arms, and "those from overseas" will lay down their arms only when a "purely military decision" has been achieved. An earnest of this will be found in the fact that by Independence Day we had sent a million fighting men overseas and that, on that day, we launched nigh upon half a million tons of shipping to keep them supplied with all necessary food and equipment.

Preparedness for Peace

BEFORE this country entered the war, talk of military preparation was unpopular with a large part of the American public. Now the pendulum has swung the other way, and while we are engaged in the war, talk of peace is unpopular. This is perfectly natural because we fear the insidious influence of German propaganda which would force a peace on this country that would be favorable to Germany. However, just as it turned out that the men who talked war in time of peace were not necessarily *Junkers* so it will prove that the men who are talking of peace in time of war are not necessarily cravens or secret allies of the Hun. We forget that we are fighting this war for peace. We do not hesitate to say that we are looking for peace; that we are expecting peace and that we are going to have peace, and the sooner the better; but we are not going to have a peace that is "Made in Germany." It is to be a genuine and lasting world peace. With that clearly in mind, the man who talks of preparedness for peace need fear no public criticism; nor will he afford any aid or comfort to the enemy.

Looking forward to the time that our men return victorious from the other side, there are a great many problems that will have to be met. As modern war cannot be conducted on a large scale without a great industrial organization to back it, we find ourselves now in a unique condition. Many of our manufacturers have had to give up entirely the work that they did in time of peace, and convert their plants to the production of war materials. Other manufacturers have had to curtail largely their peace-time pursuits, and there is scarcely any industry that has not been affected in one way or another by the great conflict overseas. It was comparatively easy to accomplish this transfer from a peace to a war basis, but it will not be so simple a matter to re-convert the war industries into industries of peace.

Many of our manufacturers have been so taken up with war production and are making such profits from the manufacture of war materials that they are apt to overlook the conditions which will face them when peace is declared; or else they are willing to take a chance on coming out of the problems of reconstruction without serious loss. But only the farsighted man will win out.

There is one thing far more important than actual sales of products that must be considered. No business organization can start up a new line of business without creating a market for its goods. The publicity and reputation once established is of inestimable value, and there is danger that many concerns will find themselves at the end of the war with their reputation forgotten, merely because they did not hold it before the public. They will be scarcely in a better position to compete with rivals than they would have been had they been starting out in business for the first time.

A few weeks ago, we sounded a warning on this subject. We noted that Germany was gloating over the fact that we were asleep because our manufacturers had neglected advertising their wares during war time. No such neglect is to be found in Germany nor in England either. The British manufacturer awoke early to the necessity of maintaining his good will before the public, and any one who scans a British automobile journal will find it filled with pages of advertising, in which there are no goods for immediate sale. The British manufacturer means to start out at the end of the war, with the same advantages that he possessed when war was declared.

The SCIENTIFIC AMERICAN is an apostle of preparedness. We talked of preparedness for peace long before we were directly involved in the war. We are still urging preparedness, and are planning to publish a series of articles on this subject. The first of this series is to appear in next week's issue, on the subject of "Coming Back to a Peace Basis." The article is written by Mr. Harrington Emerson, the well known efficiency engineer, and it will be found to contain a very original and interesting solution of one of the great industrial problems that will confront us when we have achieved a victorious peace.

Stolen Battleships

IN the enormous concentration of gun fire on the western front we have a reminder of the foul treachery of Trotzky and Lenine, when these two German agents told the simple peasant soldiers of Russia to abandon the lines, since the war was over. They did so, leaving behind them along seven hundred miles of Russian front no one knows how many thousands of guns, big and little. Also they left behind them correspondingly vast shell dumps. This war material is now on the western front taking its toll of lives, French, British, and American.

The transfer of this priceless material of war was a simple matter; for it stood just back of the Russian trenches and could be had for the taking. The German artillerymen had simply to drive over with their artillery teams and tractors, hitch up, and start on their merry way to the western front.

The betrayal of Russia secured for Germany the war material, not merely of the army but of the navy as well. These two German agents succeeded in handing over to Germany a whole fleet of warships, many of them among the latest and most efficient types in their respective classes. We cannot, because of the utter confusion in Russia, speak with close certainty about the matter; but we do know that on a most conservative estimate, the German battleship line has received a certain increase of twenty per cent in its strength, a probable increase of forty per cent, and a possible increase running up as high as fifty per cent.

The value of the ships stolen by the Germans from Russia is closely related to the present strategic situation in the naval war. If Germany is to break through the blockade against her and win a decisive fleet engagement, it must be done by the aid of battleships of the dreadnought type, supplemented by fast scouts and destroyers—and the Russian navy included a considerable fleet of just these very types of vessel. We know what ships Russia possessed at the opening of the war; we know what ships she had under construction; but we do not know to what extent Russia carried on construction during the war, and we do not know how far the crazy revolutionists may have allowed the fleet in commission to deteriorate. Another element of uncertainty is the fact that the Russians did do a certain amount of destructive work in the way of sinking or crippling ships in order to prevent Germany from adding an effective Russian fleet to her own navy. So great has been the disorganization of revolutionary Russia that we fear the work of destruction was not done methodically, or to any great extent; and it would be the part of prudence for the Allies to assume that, as the treachery of Trotzky and Lenine served to make the present German offensive on the western front possible, so also it has brought up the strength of the German battleship line to a point where the German Admiralty may be willing to assume the risk of a fleet engagement.

In the following analysis we shall consider merely those vessels which would be effective in such an engagement as the Battle of Jutland, namely, modern battleships, scouts and destroyers.

At the time of the revolution, the Russian Navy had in commission four dreadnoughts of about 23,500 tons—modern ships, designed by no less a man than the great Curniberti. They have an 8¾-inch belt, with a supplementary internal belt of three to four inches. They carry twelve, 50-caliber, 12-inch guns, mounted in four, 3-gun turrets, and sixteen 4.7-inch guns. An important point about the emplacement of these pieces is that all of them can be elevated to 35 degrees, the upper portion of the port plate being hinged so as to lift with the gun. The speed of these ships is twenty-three knots and over. They are known as the "Gangut," "Poltava," "Petropavlovsk" and "Sevastopol." The last three, it will be noted, are named after ships that were lost at Port Arthur, during the Japanese war.

More important than these are four great battle-cruisers, the "Borodino," "Ismail," "Kinburn" and "Navarin," which are between 700 and 800 feet in length and displace over 32,000 tons. They were laid down in the Baltic in December, 1912, and therefore must have been for eighteen months under construction when the war started. Whether or not, during the three years that Russia remained in the fight, construction was pushed on these ships we do not know; but, in view of the great importance to Russia of the command at least of such parts of the Baltic Sea as washed her shores, it is reasonable to suppose that an effort was made to complete these powerful ships. They are credited with twelve inches of armor on belt and turrets, and an armament of twelve, 45-caliber, 14-inch guns carried in four turrets, and also an anti-torpedo armament of twenty, 5-inch guns. The estimated speed was 26.5 knots, which in turbine-driven ships, would probably be exceeded. Thus they would be capable of maneuvering as part of the existing German battle-cruiser fleet.

Now, Germany, in striking a balance sheet between her gains through new construction and her losses by gun, mine and torpedo, probably found herself, at the time of the Russian breakdown, in possession of twenty dreadnought ships; and if she has taken over the four battleships above mentioned her fighting line has been increased twenty per cent, and if the battle-cruisers are also completed and in German hands, her fighting strength has gone up some forty per cent. We say nothing of the older pre-dreadnought ships, because they are too slow to figure satisfactorily in a modern engagement. All we are concerned with, just now, is the possibility of the Germans coming out for a line-of-battle engagement.

In fast cruisers, suitable for scouting ahead of the main fleet, the Baltic may possibly have afforded a rich haul in the four fast 7,000-ton scouts of the Admiral Butakoff class, which were laid down in the winter of 1913. Under normal conditions, these ships should have been completed. Their speed is about 30 knots and they carry an exceedingly heavy armament of fifteen, 55-caliber, 5-inch guns. The other Russian cruisers, whether armored or otherwise, are not fast enough to be of much service, and they do not possess sufficient speed for fleet action; but when it comes to the Russian destroyers great possibilities are open. We know that the Russian Navy included the "Novik" of 1,260 tons and 36 knots speed, and that over 30 new boats were, or were supposed to be under construction, that were even larger and more powerful than the "Novik." In addition to these, Russia had 20 destroyers of from 500 to 600 tons displacement and 25 knots speed and 35 vessels of about 350 tons and 27 knots speed. Now, these flotillas would constitute a most valuable addition to the German forces, particularly if the big and fast vessels of the "Novik" type have been built and are still afloat.

Let us now consider the Black Sea fleet, the most important section of which is three powerful dreadnoughts of about 25,000 tons and 21 knots speed, carrying a dozen 50-caliber, 12-inch guns in four turrets and a torpedo battery of 20, 55-caliber, 5-inch guns. They are protected by 12 inches of armor on belt, barbettes and turrets, and altogether they are very formidable and thoroughly up-to-date ships. Laid down in 1911, they should have been in commission at the time of the Russian debacle. The Black Sea destroyer fleet includes a dozen vessels of from 600 to 700 tons displacement and 26 knots speed, and nine oil burners of 1,100 tons and 34 knots speed. Presumably, the allied fleets in the Mediterranean are watching the exits from the Black Sea by way of the Dardanelles.

That our own Navy Department is alive to the altered conditions is suggested by the dispatch of our battleships to Europe, and the placing of orders to go ahead with our existing battleship program.

Wear of Guns

MAJOR-GENERAL JOHN HEADLAM, in charge of the British Artillery Mission, speaking on the wear of guns on the western front, quotes General Gossot as having said, in his hearing, as long ago as 1916: "Up to this the guns have eaten up shells; we shall now see the shells eat the guns." The General says that the French soldier was "absolutely right." At the beginning there was but little anxiety on the score of wear. So admirable was the material of which the British guns were made that their life proved, in practice, to be far longer than had ever been anticipated. But as the supplies of ammunition, and therefore the rate and duration of fire increased, the guns began to give out. It is believed that the intense heat caused by prolonged rapid fire has brought on the guns a strain which was never anticipated; moreover General Headlam found in France, Russia and Italy that deterioration in the quality of the steel obtainable since the war began was thought to have been a contributing cause. To meet the difficulty reduced charges have been introduced and strict rules have been laid down as to the length of the pauses in fire which must be observed in order to give the guns a chance to cool down. Various new substances also are now used for greasing the bore, some of them with good effect. So rapid is the wear under modern conditions, that one battle may prove the undoing of some of the guns.

Aeronautical

Four Hundred and Fifty American Battleplanes had been sent abroad or delivered at ports for shipment on July 5th, the date of the latest complete official report reaching the War Department. In announcing this figure recently Secretary of War Baker disclosed also that deliveries of Liberty motors of all classes on the same date had reached 2,514.

When Insects Take to Aviation.—According to Lieut Depret-Bixio of the French Army, who is a naturalist as well as a flying man, many insects follow captive balloons in their ascent. He has seen flies go as high as 2,970 feet, after which they die. Grasshoppers cling to the basket of the balloon until the air becomes too rarified for them, when they let go and fall. He says the swallows have a glorious time catching these insects.

Aerial Mail between Vienna and Lemburg.—A regular aerial postal service between Vienna and Lemburg has been established by the military authorities since March 31st last. It is understood that the postplanes of this service carry mostly official dispatches, although private mail is accepted if the letters are franked with a special stamp, for which the price is about four times the ordinary rate. The airplanes make the trip in about seven hours, as compared to 17 hours by express train.

Height at Which Sounds Can Be Heard.—In one of his journals Camille Flammarion gives the heights at which sounds from the earth are heard from balloons. The shout of a man was heard distinctly at the height of 1,600 feet, the sharp note of a mole-cricket at 2,500 feet, and the croaking of frogs in a morass at 3,000 feet. At 3,255 feet a man's voice and the rolling of a cart were distinguished; at 4,550 feet the roll of a drum and the music of an orchestra; at 5,000 feet the crowing of a cock, the sound of a church bell, and sometimes the shouting of men and women. Nine hundred feet higher still was heard the report of a musket and the barking of a dog. The noise of a railway train penetrated to a height of 8,200 feet, and the whistle of a locomotive engine to nearly 10,000 feet.

How Lieutenant Fonck Fights.—Some of the methods followed by Lieutenant Fonck, the leading French ace, have been disclosed by him in an interview which is reported in a recent issue of *Flight*. He believes in group formation for fighting as the time has gone for flying as an individual sport, such as it was practiced at the start by Pegoud, Garros, Gilbert, Navarre, and even Guynemer and Nungesser. "The Germans," he says, "when they inaugurated group flying, taught us and unfortunately made us pay dearly for the lesson, of the dangers attending an effete method. But I am by no means a partisan of flying in over-big groups like that of the Richthofen circus. I generally fly with two comrades—a group of three— and I am inclined to favor several groups of three sufficiently distant not to hinder each other's operations, but also sufficiently near to understand one another and give help at crucial moments. Too big a number may easily prove a peril, especially against a clever and daring enemy capable of practicing the only tactics suited to the occasion, which is to throw himself into the middle of the group, paralyzing thus his adversaries, who can neither maneuver nor fire from fear of injuring each other, while he, on the contrary, retains every facility of action. The Boches have had a bitter experience of this, as it was from a patrol of seven that I brought down my last three machines."

Storage Batteries for Aircraft.—The extensive employment of electrical apparatus aboard the fighting airplane calls for some suitable source of power, and more and more aeronautical engineers are turning to the automobile practice of storage battery and generator and away from the European idea of a magneto. Battery current is required not only for ignition, but also for engine starting, night signaling, radio telegraphy, and photography. After many months of experimenting Mr. N. D. Sturges of New York city has produced a light-weight storage battery which meets the rigid requirements of the airplane designers. In order to accomplish his purpose he has had to manufacture very light lead grids and at the same time make them of sufficient strength to hold the active material without buckling, despite constant vibration. A special die had to be invented to allow the casting of unprecedented thinness. The results have been a battery of exceptional merit, and incidentally the lightest battery ever manufactured for watt hours per pound of elements. The battery is capable of a steady current of 20 watt hours per pound of elements, which is claimed to exceed any other battery; and it is only half as heavy as the average automobile starting battery, which weighs about 80 pounds. The overall dimensions of the airplane battery are: Length 9¾ inches; width 6½ inches; height 8¼ inches. The plates are $\frac{1}{16}$ inch in thickness, nine to a cell, and six cells to a battery, or a total of 54 plates. The battery has an output of 50 amperes at 12 volts for 30 minutes.

Science

A Treatise on Radio Instruments and Measurements, for use by Government officers, radio engineers, etc., has been issued by the U. S. Bureau of Standards, as Circular 74. It includes a development of the essential theory of high-frequency measurements from simple but precise low-frequency theory, the use of reactance curves in the rapid solution of problems, descriptions of radio instruments, and formulas and data for radio work.

A Signal Corps School of Meteorology has been established at College Station, Texas, under the direction of Dr. O. L. Fassig, of the Weather Bureau. At this place more than 300 meteorlogists, physicists, engineers and other technical specialists have been taking an eight-weeks' course in meteorology. Short courses in meteorology are now included in the military instruction of the Reserve Officers' Training Corps at several universities, and a school for training meteorologists for the Navy is in operation at the Blue Hill Observatory.

A Proposed New Calendar.—The latest of the innumerable schemes for reforming the calendar takes the shape of a bill introduced in Congress last April by Hon. J. M. C. Smith, of Michigan, providing for a year of 13 months, of four weeks each, beginning with the year 1920. New Year's Day, the first day of the year, is not to belong to any week or month. A new month, known as Sol, is to follow June. In leap years a day known as Leap Day, not belonging to any week or month, is to be inserted between the months of June and Sol.

The Mount Katmai Expedition.— Owing to difficulties in connection with transportation Prof. R. F. Griggs, of the Ohio State University, was unable to lead another expedition to the Mount Katmai volcanic region this summer, as he had planned to do, under the auspices of the National Geographic Society. Two members of last year's expedition, Messrs. Sayre and Hagelbarger, have, however, returned to Alaska, taking with them pyrometers furnished by the Carnegie Geophysical Laboratory, for measuring the temperature of fumaroles in the "Valley of Ten Thousand Smokes."

An Abstracting Journal for Botany.— At the last meeting of the American Association for the Advancement of Science a number of well-known botanists formed an organization under the name of "Temporary Board of Control of Botanical Abstracts," to undertake the publication of an abstracting journal for botany, using the latter term in its broadest sense. In its permanent form the board is to include two representatives from each of the leading American societies devoted to botany and kindred subjects. Prof. B. E. Livingston, of Johns Hopkins University, has since been selected as editor-in-chief, and the abstracting of the international literature is under way. Associate editors will represent agronomy and soil technology, bacteriology, botanical education, cytology, ecology and plant geography, forestry, genetics, history and bibliography, horticulture, morphology, palæobotany, pathology, pharmacognosy, plant physiology, and taxonomy.

The Argentine Ant.—A recent bulletin of the Department of Agriculture sets forth the serious though indirect injuries done by the Argentine ant in orange groves. Owing to its fondness for the honeydew secreted by mealy bugs and other soft scales, the ant protects these pests of citrus plants from many of their insect enemies, and thus permits them to become excessively abundant. Even the armored scales, though not directly protected by the ant, benefit by the presence of the latter, as the ants eat all insects they can capture except those supplying honeydew, and, among them, many enemies of the armored scale. In Louisiana, where the Argentine ant was introduced a quarter of a century ago, the best means of control has been found to be trapping. Artificial nests are arranged in the groves; the ants congregate in the nests to avoid rain and are killed by fumigation. In California the ants are more commonly destroyed by the use of poisoned syrups.

To Improve the Climate of the Kalahari Desert.— Schemes are put forth from time to time to improve the climate of arid regions by creating large bodies of water in their vicinity. The latest plan of this kind comes from South Africa, where Prof. E. H. L. Schwarz, of the Rhodes University College, has set on foot a project to produce a new lake larger than Tanganyika in the midst of the Kalahari desert by the building of weirs across certain rivers. It is claimed that great lakes formerly existed south of the Zambesi in the region now covered by the vast swamps of the Ngami and Makarikari basins, and that their drying up has been due to the diversion of the Upper Kunene and Okavango Rivers and associated streams from their old courses. The plan contemplates building a weir across the Kunene near the gorge at Kinga and another across the Chobe (Linyanti) a little above its junction with the Zambesi, at a total cost estimated not to exceed a quarter of a million pounds. The promoters predict increased atmospheric humidity, a fertile soil, cessation of the devastating hot winds from the desert, and relief from invasions of the locust swarms that now breed there.

Automobile

Gas Containers.—Since they began to use illuminating gas in England to operate motor cars many plans have been tried out for carrying the required supply. One of which much was expected, was a semi-rigid container made of rubber and canvas, or other proofed fabric. A committee appointed to investigate the gas question has decided that such containers should not be larger than four inches, internal diameter, and the pressure limited to 90 pounds. As a container of this diameter, and 10 feet long would hold less than 5 cubic feet of gas at this pressure, it would require 46 such cylinders to hold the equivalent of one gallon of gasoline.

Conserving Tires.—One of the most serious and costly items in maintaining an auto car is the replacement of tires, and with the reduced supply of rubber, and the rapidly increasing requirements for this material in many directions, these expenses are sure to soar for an indefinite period. Much of this outlay might easily be avoided if people would only learn a little about the proper care of tires, information in regard to which would be gladly furnished by any tire manufacturer. It is authoritatively stated that fully 60 per cent of all the tires used go out of service prematurely because of insufficient inflation; 30 per cent more go out of commission because of neglected tread cuts; the remaining 10 per cent go to an early grave because of wheels out of alinement, brakes working unevenly, and other minor causes.

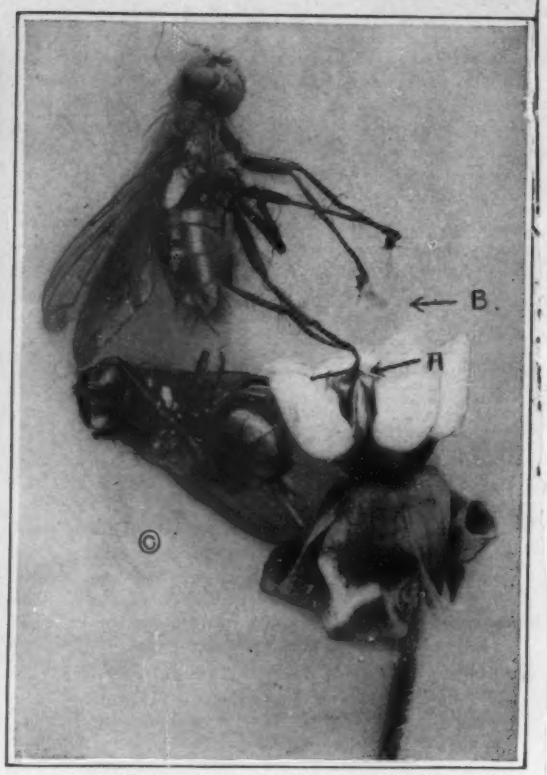
Motor Transportation.—The people of this country had a plain and forcible warning last winter of the pressing necessity for motor transportation to make up for the deficiencies of our railroads, and of the inadequacy of our roads systems, superficial character of construction in many cases, and lack of proper maintenance. But what is being done to remedy the situation? It is true that some associations are talking of appointing committees, but these would be composed of men already burdened by the necessities of their own business affairs, and committees are notoriously procrastinating and time consuming. This matter of promptly providing for efficient long distance motor transportation is at the present time hardly less important to the country than rail transportation, and therefore a subject for action by the national government, in charge of men who should devote their entire time and attention to the subject and adopt strenuous methods to secure immediate results.

Limiting the Use of Gasoline.—Notwithstanding the rosy predictions of an adequate supply of gasoline there is a strong probability that measures will have to be taken in this country to economize to meet the requirements of the immense quantities that will be required for our army transport service abroad, for a great fleet of torpedo boats and submarine chasers, for the rapidly increasing numbers of farm tractors and for our home motor transport work. If restrictions in the use of automobiles becomes necessary it might be well to start early and feel our way by first prohibiting the use of certain unnecessary classes of vehicles, as has already been done on the water by cutting off the supplies for large pleasure yachts. For example, the use of excessively high powered pleasure cars might be prohibited with advantage; and at the same time everyone convicted of driving recklessly, or when intoxicated, or of flagrant violation of speed regulations should have his license revoked. Such measures would not only result in a very considerable saving of gasoline—an important consideration—but would make the roads safer for all users.

Burning Low Grade Fuels.—In a recent paper before the Society of Automotive Engineers an engineer who has made a special study of the subject said: "With a heavy fuel engine some means other than carburetion must first be provided for the most intimate mixture of the fuel and the air, and some means of igniting this mixture other than an electric spark is necessary. Carbureters fail to form an intimate mixture of heavy oils with air because the heavy oils do not volatilize sufficiently well, and the mechanical division of the oil secured in the carbureter is never sufficiently fine to form a combustible mixture. Heat applied to the carbureter in order to assist in volatilizing the oil results in heating the air, and thereby reduces the output of the engine. An ordinary electric spark will usually fail to ignite a mixture of heavy oil and air because the source of heat is too localized and the flame propagation is much slower than in the case of a readily volatilized vapor mixture with air." These principles are also applicable, to a greater or less degree, all along the line of "distillates" down to kerosene, and even to some of the low grade gasoline now on the market; and although engine designers are reluctant to recognize the situation, as evidenced by the numerous "hot spot" devices and superheated manifolds now being offered, the more far-seeing engineers realize more forcibly than ever before that the time is near when the entire system of supplying the "mixture" to the cylinder will have to be radically revised.

The flower of the milkweed

The seed-pod of the milkweed



Flies (Pollinia rudis) trapped by a single milkweed

A Flower That Catches Insects

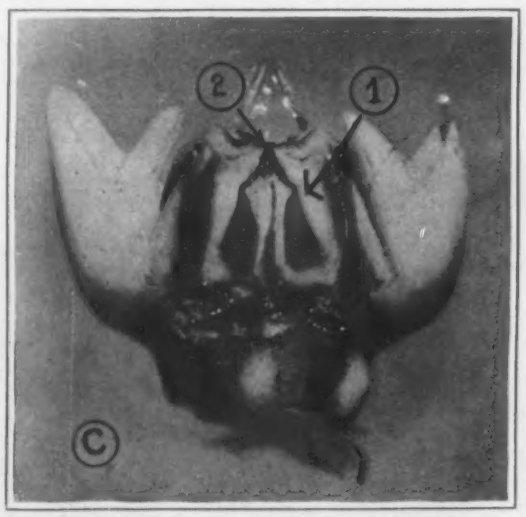
A Little-Known Characteristic of the Common Milkweed

By Arthur J. Eldredge

EVERYONE who lives in the country is acquainted with the milkweed. The common variety grows from two to five feet in height. It has stout stems, large ball-like clusters of dull purple flowers that have a delicious spicy odor. The botanist calls it *Asclepias syriacus* to distinguish it from the many other milkweeds not commonly known. It wilts when picked, few people knowing how to revive it. The milky juice is very sticky, which also prevents picking. In the western grain fields it is frequently troublesome but in the East it is found mostly by the roadside and in uncultivated ground.

If one sits near a plant some summer day one will be surprised at the number and variety of insects that are lured to these spicy flowers. There are many kinds of flies, bees, beetles, wasps and butterflies. Some bee keepers will assert that the flower has poisonous nectar which kills the bees. This is not true; but the plants are often mowed where such impressions exist.

Insects are attracted to flowers usually by bright colors, fragrance, pollen or because of much nectar. They come to get these things for themselves, but in so doing help nature to produce seeds. Most of us have seen those large pods on the milkweed in late summer filled with such wonderful silky threads which fly away on the breeze carrying a seed. In childhood we have sat on the hillside and blown these silken parachutes from their case, watching them sail far, far away into the blue sky and wondering where they would come to earth. Each pod means that an insect visited the flower from which it grew, because the milkweeds would never produce any seed unless some strong-legged insect came to help. In doing this, perhaps he broke some legs off to be free, perhaps he was held fast until death and was eaten by a wasp or hornet. Perhaps it was a strong solitary bee who lost neither life nor leg, performing the task unconsciously for many flowers without bothering him a bit.



Part of the flower removed to show pollinia
(1) Pollen mass; (2) Corpusculum

More highly magnified view of fly caught by milkweed

This is a wonderful process, not without tragedy. Let us watch to see how it happens. There comes a butterfly; he walks about on the flower, uncoiling his long tongue to draw out the nectar. Now he flies away; we did not learn much from him. A large wasp comes and is gone without telling us the secret. There is a honey bee groping around for a good foothold while she extracts nectar from the five pockets. When she has taken it all and will go to the next, something happens. Her feet are caught; she struggles hard for a minute or two before they come out.

Did you see those small yellow things dangling from her toes? We are finding out something. Let us wait. Perhaps we will discover it all. Here is a house-fly for his share of the treasure. No! look again, he is similar to our common pest but it is the harmless cluster fly. His name is *Pollinia rudis*. He is ready to leave but cannot, his feet are held by the flower. He struggles and twists, but is held more securely. Examine the flower and its captive. You will see that the flower is composed of tubular sections between which are narrow closed slits. On either side of this slit and covered by tissue is a yellow mass of pollen, quite clear and hard. It is one of the pollinia. They are connected by a thin strap-like strip in the middle of which is a dark mahogany colored piece called the corpusculum. This corpusculum has a slit on one side and sits at the upper end of the slit seen in the figure above, the two openings being alined When the fly reaches down the side of the flower to find a hold, his feet slip into the slots (A), and as he withdraws, they slip upward, his toes catching in the cleft of the corpusculum and being held fast.

The honey bee is strong and usually able to pull the pollinia out quite easily. Sometimes when caught by both feet she dies on the flower. This doubtless leads to the idea of poison nectar. A bee may visit many flowers without extracting any pollinia, and again she may carry two or three pair on one foot. Holding to the next flower as to the first, the pollinia are drawn through the slot into the flower thereby pollinating it so it will produce seed.

The weaker insects are seldom able to free themselves when well caught. Often they escape by breaking legs off close to the body. Wasps and hornets know that the milkweed often holds these captives for they are fond of flies. When a wasp comes many free themselves because of fear. It is much more pleasant to lose a leg or two than to be eaten alive. As night comes on doubtless the prisoners crouch in fear of enemies that soon will come from hidden places in search of food. One evening while watching some milkweed flowers, I saw a fly struggling in the hold of a silken thread, while with his long arms a spider reached out to add strand upon strand until at last the fly was exhausted and lay still, when the spider came slowly to his feast. Can you not imagine the fly exhausted by long struggle slowly stiffening in the cool evening air? Soon he sees coming up over the horizon of the flower cluster those long, jointed legs which he instinctively knows are the forerunners of death. This fires him with new strength, but he becomes quiet again only to feel the net drawn closer. It is unbreakable. There is no escape. His doom is sealed.

This is one example of the importance of insects and we see there is some tragedy in it. These are some of the common things we brush aside in our daily walks, many of which, perhaps, have a direct bearing on our own existence, or if examined more closely may give us many hours of pleasant and profitable study.

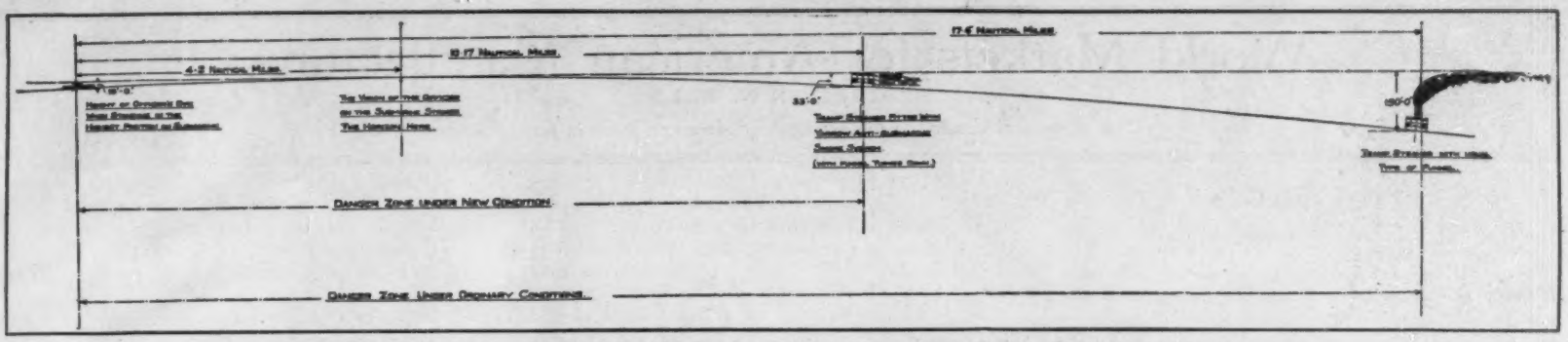
Live-Stock Feed Prepared from Fish and Fish Offal

A FACTORY has been started at Ymuiden, at the entrance to the North Sea Canal, for transmuting the least desirable fish and fish offal into a satisfactory food for swine. This is considered of double importance — it feeds the swine and also frees articles (maize, for example) usually fed to swine for other purposes, even for human food.

Spoiled fish have been fed to swine, but with bad effect on the taste of the pork. The new factory, it is estimated, makes a "vischmeel" (literally, fish meal) from the material it uses, which product, analysis shows, contains 55 per cent albumen and 12 per cent pure fat, and also realizes an oil that, after suitable purification, could be used in competition with cod-liver oil, or in any case could be very useful as an industrial oil.

It is suggested that besides feeding swine with this new product it be tried with cattle, as a possible aid in the serious situation which now exists in regard to feeding live stock.

The new factory is considered of great importance in scientific circles, and hope is expressed that the government as well as the general public will give it earnest support as a matter of national concern.



By spraying the smoke down to the water, the danger space for the merchant ship is reduced from 17.4 to 10 miles

Spraying Smoke Clouds Out of Sight

New Method of Dissipating Steamer Smoke in the Submarine Zone

SOME thirty years ago, in the early days of the development of the torpedo boat, the firm of Yarrow & Company were requested by certain of the foreign governments, for whom they were building torpedo boats, to devise some method of preventing the location of these little craft from being disclosed to the enemy by the smoke from their funnels. In response, they devised a plan by which the smoke could be directed downwardly toward the surface of the water, and some of the torpedo boats built by the firm in that early time were designed without funnels of the ordinary type.

Sir Alfred Yarrow has been directing his attention to this subject once more, and recently he gave a lecture to British ship owners and Underwriters at Lloyds in London on the necessity of avoiding smoke clouds in the presence of an enemy. The results of his experimental work and the means adopted in its application to merchant shipping are shown in the accompanying photographs.

It is well known that the first indication, on a fine day, that there is a steamer in the far distance is the trail of smoke which, under certain conditions, reaches high into the heavens. It is estimated that, on the average, the smoke will rise to about one hundred and fifty feet above sea level. At this height it can be seen from the bridge of a submarine at a distance of over seventeen miles, the eye of the officer in command of a boat being assumed as about fifteen feet above the level of the sea.

If the smoke, instead of ascending, were caused to descend so that it never rose above the level of the bridge, an ordinary cargo vessel would first become visible above the horizon at a distance of 10 miles. From this it follows that, if some means could be found for driving the smoke down toward the water instead of permitting it to rise skyward, a vessel of the average type would be able to pass between the 10- and the 17-mile radius from a submarine without being observed.

When the officer in command of a submarine or a raider sees the smoke of a vessel in the distance, he at once heads for her at full speed so as to place himself in position for attack. As an indication of how immediately and regularly this is done, attention is directed to the following extracts taken from the cruise of the German raider, "Karlsruhe," which was so active in the opening months of the war, a translation of which was given recently in the United States Naval Institute Proceedings:

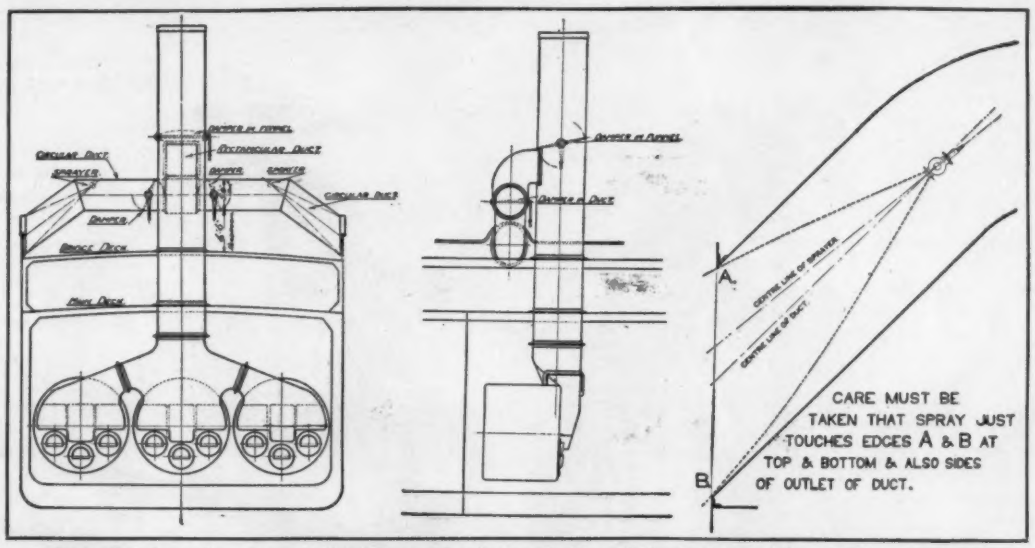
August 6th, 1914. "In the middle of these proceedings the lookout on the foretop reported at 10.15 'a smoke cloud to the south'; soon after, two masts and three smoke pipes could be seen."

Later the same day. "The 'Karlsruhe' was making 21 knots. We could still see their smoke clouds which, like ours, rose vertically, until 4 P. M." (The "Karlsruhe" was running away from a British cruiser.)

August 7th. "We were all at high tension wondering in what direction the first smoke cloud would appear."

August 18th. "At 4 P. M. the lookout reported 'a smoke cloud ahead.' Afterwards a steamer with one smoke pipe appeared."

September 17th. "We were downcast over our bad luck in having to leave the main commerce lane, when our lookout reported 'smoke 4 points to the port bow' and our ship immediately livened up."


Circular Duct
Sprayers
Bridge Deck
Main Deck
Rectangular Duct
Circular Duct
CARE MUST BE TAKEN THAT SPRAY JUST TOUCHES EDGES A & B AT TOP & BOTTOM & ALSO SIDES OF OUTLET OF DUCT.

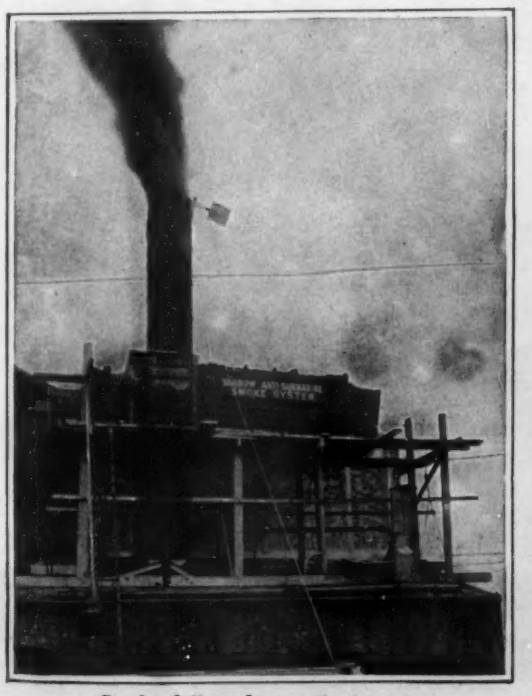
These drawings show the mouth of the smoke duct and side and front views of the complete apparatus

The plan for keeping smoke down, which Messrs. Yarrow have adopted, consists in carrying a horizontal duct from the base of the smoke stack, at an elevation of about six feet above the deck, to the gunwale of the ship on each side. The slope of the duct is about forty-five degrees from the horizontal. Just above the point of union of the ducts and the smoke stack, there is a damper in the latter, which prevents the smoke and waste gases passing upward, and causes them to flow out, either on the port or starboard side of the vessel. The side to which the gases are deflected is determined by suitable dampers, and is dependent upon the direction of the wind, the smoke being diverted, of course, to the lee side of the vessel.

A most important element in the device is the introduction of a spray of cold water, delivered at high pressure, at the mouth of the duct, the spray passing out with the products of combustion. It cools the gases and has the effect of causing them to fall toward the water in place of ascending. In operation it is found that the smoke is actually forced down by the spray to the surface of the water, where it remains, and practically none of it rises higher than the level of the bridge.

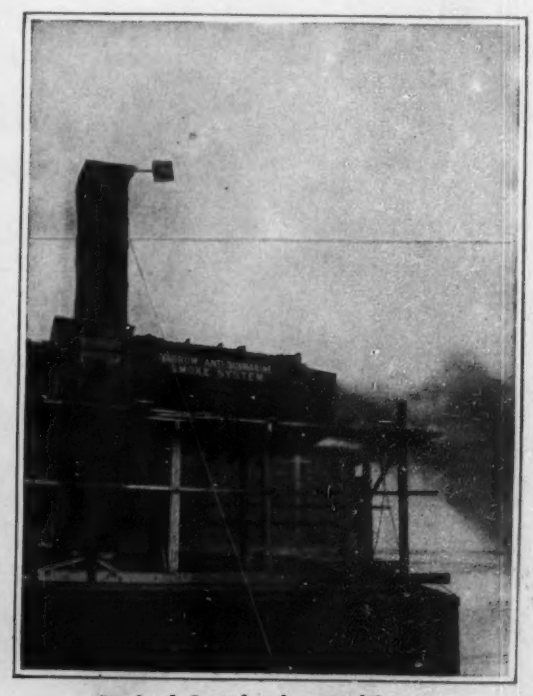
It would be expected that, by doing away with a portion of the smoke stack, the draft would be diminished; but that is not the case. The spray, issuing at high velocity, produces an induced draft, which is even greater than that due to the loss of height in the funnel. In an ordinary merchantship the vacuum in the smoke

(*Concluded on page 76*)



Smoke delivered normally through stack

This view shows how the smoke is driven downwardly by cold spray



Smoke deflected and sprayed from horizontal duct

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

Prosperity in Cuba

THE United States bought more than $200,000,000 worth of Cuba's sugar in 1917 and the island increased its imports of American goods by more than $32,000,000. We have few better customers than Cuba, which took more of our products last year than any other country in this hemisphere except Canada. With more money at hand than it can spend and prospective revenues limited only by future sugar crops, Cuba is living high.

An American business man who visited Santiago recently was astonished at the amount of wealth to be seen in that city of one-story dwellings. "The poorest shack has a lot of valuable furniture in it," he writes. "This was a surprise to me because I always associated poverty with a tropical climate. Prices make a New Yorker feel at home. I had lunch at the 'Casa Grande' —curried rice and chicken, French fried potatoes, coffee, and an alligator pear—for which $1.40 was charged. There was no bread which commands famine prices here just now, but there is a superabundance of meat products."

Prosperity connotes the automobile. We have exported more than 10,000 cars to Cuba during the last three years. To quote a member of the Cuban diplomatic corps, "The Cubans are all purchasers of the necessities, comforts, and luxuries. All have money; the workingmen, farm hands and laborers get good wages and they spend their money for things they want." Automobiles may be placed in all three classes of goods bought by our neighbors. In Cuba, as elsewhere, they are important in the transportation system. The streets of Havana are well paved. Good rural roads are found throughout the island and they are being extended. These highways, of which more than 1,250 miles are excellent macadamized roads, are ideal for automobiling, averaging about sixteen feet in width.

The American Consul at Cienfuegos reported in May that there were 19 commercial motor cars, 104 private passenger cars, and 202 public passenger cars in use in that city. "The total will increase as the improvement of the streets and highways proceeds," he added. "The larger motor trucks are being used for hauling railroad construction material, and the smaller types give service as delivery wagons."

Low or medium-priced cars have been in most demand, but sales of higher-priced machines show marked gains since the entrance of more American manufacturers into the Cuban market. The most satisfactory introductory method is to send competent representatives acquainted with trade conditions and the customs of the people and thoroughly conversant with the Spanish language.

An important point in connection with the sale of American automobiles and other products in foreign countries is the registration of the manufacturer's trade mark. If an unauthorized person, for purposes of speculation, takes it upon himself to do this there is nothing in the laws of a number of Latin American countries to prevent him and the result is costly for the manufacturer. The protection of an automobile trade mark is essential because of its relatively high value.

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American cars on a Cuban highway near Havana

The Economic Conquest of Russia

REVOLUTIONS are a part of evolution and Russia's case is complicated by a world war that is draining the country of its resources and yielding nothing but misery in exchange. To those who can not see the possibility of an early return to law and order it seems like wasting time for American merchants to make any definite plans for resuming trade with Russia. Ever since the fall of the Kerensky government and the turning of liberty into license by the Bolsheviki business relations between the United States and Russia have been practically suspended.

The greatest economic battle in history will be fought on Russian soil. For some time the Germans have been looting the European part of Russia, and they are now extending their pernicious methods to Siberia in an effort to complete the wreck and obtain all the salvage. Our ability to thwart the plans of our enemies will have a decided effect upon the duration if not upon the result of the war.

President Wilson has decided against armed intervention on our part, and we shall send agents of construction instead of destruction. An American commission of commercial and industrial leaders will visit Russia to find out what is needed for the country's rehabilitation. The commodities recommended as necessary will be licensed freely for export from the United States and ships will be provided to carry them to Siberian ports whence they can be distributed in the interior.

After supplying Russia's urgent need for food and clothing we shall deal with the transportation problem. Many thousands of miles of railways must be built. Although Russia now has the longest continuous line in the world, the 6,000-mile Trans-Siberian Railway, it is little better off today than the United States was in 1869, when the Union Pacific was completed. It is calculated that after the war Russia will have to build from six to seven thousand miles of railway annually. American locomotives worth more than $11,000,000 were exported to Russia in 1917, as compared with less than $4,000,000 worth in 1916, and the value of our shipments of railway track material to that country increased from $4,400,000 in 1916 to $5,865,000 in 1917. There was a marked decline, however, in exports of freight cars last year, only $2,000,000 worth being sent in comparison with the $12,000,000 total in 1916. This trade in railway equipment has originated since the war started.

A few years ago Russia was the greatest grain producing nation of the world. Today she hungers and the famine that confronts her threatens to be one of the greatest tragedies ever known. Her farms have been stripped of men, animals, machines, and materials. Without aid, Russia will starve. She was beginning to become really acquainted with agricultural machinery when the war began. Potentially Russia offers by far the greatest selling field for American tractors, plows, and implements of any country in Europe. The United States exported $5,400,000 worth of mowers and reapers to European Russia in 1917 and this figure surpassed the 1913 shipments of all agricultural implements. Last year we sent nearly twice as much binder twine as we did before the war.

There is encouragement in a report that the State Department has authorized the shipment of 50,000 pairs of shoes to Russia. Although they are destined for Moscow, the American exporter will be responsible for preventing them from falling into the possession of the enemy. After the arrival in Russia of the American economic mission it is likely that a considerable trade revival will take place, and the fore-sighted American exporter is now making a study of opportunities in the greatest of the world's markets. Occupying one-sixth of the land surface of the globe, Russia offers an unlimited field for the sale of American products.

Russia's tremendous financial difficulties will have to be met by the development of its natural resources immediately after the war. Timber is the greatest of its riches, its 1,125,000,000 acres surpassing in extent the timber land of all other countries. For reconstruction in Europe large quantities of timber will be needed and if its industry is properly developed Russia can supply in most part the demands of the belligerent nations. Platinum, which now leads the precious metals, is found in the Ural Mountains. If these deposits are to be saved from the Germans' grasp we must deal some telling blows, and none will be more effective than the investment of American capital in the exploitation of Russia's natural wealth.

The remarkable success of the German trader in Russia before the war was due to a commercial treaty that favored German interests to a marked degree and to the employment of business methods that Americans would do well to examine. Their salesmen spoke Russian fluently, distributed catalogs in that language, and extended liberal credit. Hamburg and Bremen were formerly the chief gateways to European Russia, so Germany was credited with large amounts of imports and exports actually representing transshipped goods.

During Russia's present commercial illness we should not forget the striking economic development of the country in the decade preceding the war. In that time its national wealth almost doubled. The production of coal, iron, and copper increased rapidly. The number of Russian business houses rose from 862,000 in 1901 to approximately 1,500,000 in 1914. In the opinion of a well-known authority, Russia's present situation is not worse than that of the United States after the Civil War. With its large population, its inherent possibilities, and its demand for liberty, Russia needs only a helping hand to enable the continuance of its progress. The United States is best prepared to furnish the necessary aid, and the manner in which we meet the Russian problem will be a direct measure of our ability to combat Germany commercially and to seize the greatest opportunity that has ever arisen in the world's markets.

Uruguay Wants Direct Trade

BECAUSE Montevideo is only 25 miles from Buenos Aires, the latter port has been used as a trade center for Uruguay by many American shippers. That such a plan is unsatisfactory to the Uruguayans is evinced by this statement of a Montevideo merchant to the representative of a New York firm: "We want you and your friends to do business with us direct. Don't make us do it through Buenos Aires. We have a fine city of half a million people, and we want to deal directly with you."

Although Uruguay is the smallest of the South American republics and its population is not much more than 1,500,000, it is an attractive market for American goods because of the continually rising standard of its people, its excellent transportation facilities in normal times, and its increasing imports of foodstuffs, iron and steel, glass, woodenware, oils, chemicals medicines, stationery, toilet articles, tobacco, textiles, shoes, hats, and silks. The growing manufacturing interests cannot begin to meet the country's needs, with the consequence that it must depend almost altogether upon the importation of foreign goods.

In 1917 Uruguay imported $18,400,000 worth of American products, against $11,850,000 worth in 1916. After the war we shall meet some spirited competition in this market, where English capital is heavily invested. The ten cities with a population of 10,000 or more offer a good opportunity for the sale of higher-class articles. American exporters will profit by arranging for representation at Montevideo and extending their business in the region tributary to it.

The Uruguayan Government recently created a National Bureau of Commerce, among the functions of which are to furnish information concerning the commerce and industries, legislation, railways, shipping of the country and to aid merchants and manufacturers in the importation and the exportation of merchandise, especially under abnormal business conditions due to difficulties imposed in other nations.

Rabbit Pest in New Zealand

AS a fair illustration of the rabbit pest in certain portions of New Zealand, and especially in the drier sections of the South Island, it is stated that on an estate lately taken over by the New Zealand Government comprising 12,446 acres of freehold and a pastoral run of 19,250 acres there were killed or captured about 120,000 rabbits in order to clear up the property so as to make it suitable for the location of returned soldiers.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Making an Asset Out of a Liability

To the Editor of the SCIENTIFIC AMERICAN:

Traveling around from one city to another in my line of work, I have had opportunity to swim in many score of little lakes, and especially in Ohio, Michigan and Indiana. At the bottom of all the lakes is a deposit of very rich humus, sometimes as much as twenty feet deep in a 1,000-acre lake. This humus would be of enormous value to the land in the immediate vicinity of the lakes.

As the great cry is for fertilizer, more fertilizer and still more fertilizer to feed the starved soil of this country and Canada, and as nearly all the little lakes are rendered quite foul through the presence of the great mass of muck lying to considerable depths at the bottom of thousands of lakes in this country, why not have a land moving suction dredge move from lake to lake in each state to reclaim this vast valuable product that has been washed to those centers from the hillsides?

I know one fair-sized lake in Wisconsin that is so foul in August that no particular person will swim in it. The mass of matter has been accumulating for centuries and just lies waiting to be mined by machinery. I well remember giving an exhibition of swimming in the mouth of a river at the old Yale Boat Club. When I stopped to make an explanation of my demonstration, I attempted to stand up for the moment but found that what looked like bottom was a mass of rich slime, coming over my head by several feet.

As I very much like to look upon the bright side of everything, instead of a revolting sensation passing through me at the feel of the disgusting mass, I thought of the immense amount of wealth surrounding my body. Let our Agricultural Departments reclaim this plant food.

G. H. CORSAN.

Toronto.

The Nose Spin Problem

To the Editor of the SCIENTIFIC AMERICAN:

In regard to Mr. Geo. W. Williams' article, entitled, "The Nose Spin," I would like to advance a theory of my own toward the solving of this vexing problem.

I do not believe Mr. Williams' suggestions of using reversible propeller shafts or propeller pitch are practical as both would demand bulky mechanism and numerous bearings.

On the under side of the fuselage of every airplane are attached two pneumatic tired wheels, whose uses are obvious and need not be dwelt upon. The wheels, from necessity are stout, and have substantial bearings; suppose then, that in each of these wheels we attach a small four-bladed propeller made of aluminum or some light metal, or wood. We will place them so they work together, that is, displace the air in the same direction when rotated.

In the hub of each wheel will be attached a spur gear, which will be engaged by a like gear on a flexible shaft, that enters the under side of the fuselage near the rear end of the engine. To these ends of the shafts will be coupled two friction wheels (with coil spring tension and foot engagement and release rachet), that engage a friction plate bolted to the crank shaft.

These shafts will be geared so that if the motive propeller turns clockwise, the small equilibrium propellers will displace the air from left to right. The resistance then set up will naturally right the machine, as the planes always rotate in the opposite direction of the motive propeller's torque.

FRED K. FRETHEIM.

Brawley, Cal.

Shell of 75-Mile Gun

To the Editor of the SCIENTIFIC AMERICAN:

Isn't there a probability the French drawing of the German 75-mile shell, made from fragments in Paris, which you reproduce, is shown reversed? What is supposed to be the nose is more likely the tail and the "rounded plug" the nose. If you turn it around you will have the stream line projectile, but as it is shown all the weight and body is on the wrong end. If fired in this position it would change ends of its own volition and send its heavy end in front, unless the gyroscopic forces prevented, and this is not likely after being nearly spent in its flight. The only thing I see in the drawing against the theory of the stream line projectile is that the rounded portion of the plug does not extend to the periphery, but since we have done little or no experimenting with the stream line idea, we know very little about it. If the shell is of stream line construction the employment of a gas check cup to fit the tail piece is necessary. (See my letters in your "Correspondence" May 6th and September 30th, 1916).

The milling of the shell, if made of hard metal as stated, would certainly be destructive to gun liner, and apparently a hazardous practice.

The disk dividing the chamber may serve to separate two forms of explosives—one ignited by fuse and other by shock, which would increase percentage of explosions and leave nothing but fragments to be examined.

ELI E. GREGORY.

May 13th, 1918.

Limits of Safety in Canned Goods

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of May 18th contains an article headed, "The Canned Food Myth," dealing with "the popular belief that canned foods will be dangerous if left in the tin after opening." The inference is that it has been shown that they will not be dangerous.

The tests quoted, however, are of condensed milk and of certain vegetables. Do you want your readers to understand that the same tests have been applied to canned soups, fish and meats, and that those materials can also be eaten with safety after standing in the can? If not, is not your wording quoted above misleading, and possibly mischievous?

A. T. RICHARDSON.

Fullerton, La.

Ship Plates and Explosions

To the Editor of the SCIENTIFIC AMERICAN:

Mr. Maxim states that in his ship design, a considerable part of the force of a torpedo exploding against the side of the ship will be absorbed in pulverizing the concrete.

That concrete has the property of not transmitting the shock of explosion very far beyond the part most effected. Couldn't the same effect be produced, by weakening the steel plates with many irregular and jagged cuts on the inside? This would cause the force of the explosion to act along the lines of weakness caused by the cuts and thus perhaps prevent plates tearing apart at joints. A considerable part of the force of the explosion would be absorbed by tearing along many lines of weakness. One might say that the energy expended in tearing is proportional to the area of the tears. The greater the number of tears and the more irregular they are, the greater the area. Therefore, greater amount of energy absorbed.

In a steel ship, the plates being so much stronger than the joint lines, a great portion of the force of an explosion is concentrated along the joints lines, easily breaking them and making a very large hole.

If many lines of weakness are made in the plate, a whole lot more energy will be absorbed before the explosive blast breaks through. Also the hole made will be smaller.

Near this city there's an enormous deposit of volcanic cinders. They are tough and soft. A nail can be driven into them as into a piece of wood. One might think these cinders would be easy digging. The fact is, they are harder to dig out or blast out than the hardest kind of rock. Repeated charges of powder in the same hole produce no effect except to make the hole a little larger. The explanation of this is, I suppose, the force of the explosion is absorbed in breaking the walls of a multitude of cells in the cinder.

Is it possible to make steel sponge? If so, what would be the matter with making plates of it, say about three or four inches thick and place them in the torpedo belt of a ship. Judging from the resistance the volcanic cinders offer to an explosion in it, the resistance of a steel sponge three or four inches thick, to an explosion against it would be enormous.

Prescott, Ariz. WILLIAM CROCKER.

Form of Rifle Bullets

To the Editor of the SCIENTIFIC AMERICAN:

In your latest SCIENTIFIC AMERICAN magazine issue, June 1st, 1918, in article entitled "Bullet vs. Armor," you pointed out that the United States armor-piercer stuck, when three-fourths through. May I suggest that a conical base would remedy this tendency, inasmuch as the lead coating crowds the passage, producing a jamming effect. You will notice that the Huns are using a conical base rather than a boat-shaped base. Perhaps this isn't worthy of your consideration, or perhaps the ground has already been covered. But sometimes big people overlook small details.

JOE BOBBIN.

Calumet, Mich.

A Ship Railway at Niagara

To the Editor of the SCIENTIFIC AMERICAN:

It was only late last week when it came to my recollection that some years back your paper published a plan for a canal around Niagara Falls in which the designer proposed to make the change of level in one shift by some form of lift lock. I can not recall any of its details or the lift machinery, but no doubt your index will locate it in your files.

Current discussion seems to have renewed this project in various forms; and I want to add my suggestion to the others. A good many years ago Captain Eads worked out a plan to transport ships by rail across the Isthmus of Tehauntepec but it was only another engineering dream that did not materialize. His idea could be used for a single lift at Niagara Falls by putting as many trucks and lines of rails as necessary under the lock tanks and rolling them from one level to the other. The tanks can be made to balance each other by cable connections or run independently as there is abundance of power to operate either way. If the railroads are made three miles long the grade will be 109 feet per mile and a number of mountain divisions use as heavy a grade in safety.

Philadelphia, Pa. J. G. STEEN.

The Sense of Smell in Insects

To the Editor of the SCIENTIFIC AMERICAN:

I read your paper regularly, and was much struck by your paragraph in the issue of March 2d, 1918, on the sense of smell in insects. The ordinary man in the street ridicules the idea of any insect being able to smell anything, and if you argue with him he triumphantly says: "Well if he does, where's his *nose*?" And the argument is finished. Let me relate to you an experience of my own *re* the power of smell in our Australian blowfly. Being more or less of a curse, he is of course ubiquitous. You find him in the Kosciusko Mountains and elsewhere in our snowy regions, as well as in our hottest country, all the year round.

One day during a drought, I was riding across a large plain with a friend. Not a tree within sight, nor a shrub or bush, and no grass. At times my friend bled freely at the nose. About half way across the plain, blood began to flow. We stopped. He dismounted, put one hand on his knee, leaned forward, and allowed the gore to drip slowly on to the dusty plain. Within 15 seconds we heard the buzz of a blowfly and saw him alight on the ground within a couple of inches of the blood. Then another, and another—in fact several others arrived within the space of a minute or so.

Now I am quite sure that we did not bring those blowflies with us across that plain. Neither did our horses.

Out in Australia every sportsman knows that as soon as he shoots any game or hooks a fish, he must protect his capture against the blowfly, and I can easily imagine flies discovering dead game very quickly.

But just think how keen the sense of smell in a blowfly must be, that can go straight to a few drops of blood, let fall in the dust. I don't imagine it could have been anything else but sense of smell that guided those flies to the exact spot where business could be done by them.

R. J. ROTTON.

Sydney, New South Wales.

Why Bode's Law?

To the Editor of the SCIENTIFIC AMERICAN:

Why Bode's Law? More exactly, why do we have a tendency for each planet to be a little more than half way out to the next? If you have no better theory, what do you think of mine?

This was suggested by viewing Roberts' picture of the Nebula of Andromeda. Why are the "lanes" located as they are? If they are ring-openings, caused as are those between Saturn's rings, after the remotest planet was formed from the parent nebula or captured by it, the two outermost rings would tend to form at distances x and y given by the equations

$$x^3:1^3=1^2:2^2, \quad y^3:1^3=1^2:3^2,$$

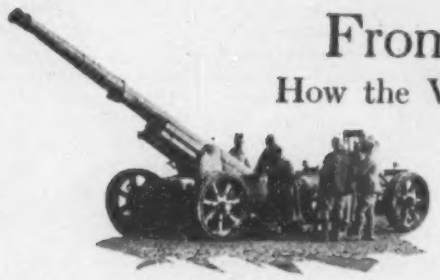
or, to two places, $x=.63$, $y=.48$.

If we take the earlier theory of planets given off from a parent nebula, this ring between .48 and .63 would tend to form a planet at about .56, as it is more heavily weighted on the outside. That is, a little more than half way out. If we hold to the capture theory, and that the second captured body would tend to be at the distance of the outer lane caused by the first, it would be at .63. After this the mathematics is more complicated, as we have several bodies tending each to produce its own system of lanes. If Neptune be at distance 30.05, Uranus should be at $.63 \times 30.05=18.93$. The same should apply to Jupiter's moons (4) and (3); and it actually does.

T. M. BLAKESLEE.

Ames, Ia.

[Our correspondent has got hold of an intelligent suggestion regarding one phase of a very complex matter. The principal objection to his view is that there is no evidence that the outermost planets were formed first. There are so many other factors involved in the very complicated problem of the origin of the solar system that we should hesitate to attach controlling importance to this one, though the mutual perturbations of the motions of the masses which ultimately formed the planets must have had a good deal to do with character of the orbits into which they eventually settled down.—EDITOR.]



From the Trenches to Open Warfare

How the Von Hutier Method of Attack Broke the Deadlock on the Western Front

ARMCHAIR strategists came into their own on March 21st last. For on that day the Germans began their big offensive against the British, and aside from immediate results in the form of prisoners, booty, and a wide expanse of captured territory, they succeeded in breaking on a wide front the trench warfare which had prevailed since 1914. The deadlock was broken. But it was certainly not accomplished in the manner often suggested by armchair strategists. It was a far more formidable plan than any anticipated by would-be military experts. Incidentally, it required a far greater number of troops than any one had dared think of in connection with a single battle. And, lastly, it was born in the conference room at Brest-Litovsk, when Russia was placed at the mercies of the German army by Trotzky, Lenine and others.

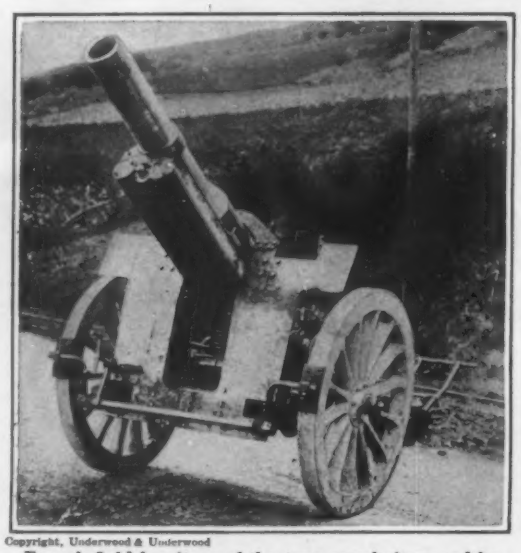
It has been a common fallacy to consider the front in France as being unbreakable, or at least, to consider trench warfare as the only modern way of fighting. Yet on more than one occasion the trench system of both sides has been broken on a small front; indeed, as early as May, 1915, the French broke through the German defenses north of Arras, and it was only the lack of means to follow up the break, as well as the promptness with which German reinforcements dammed the break, which prevented the French from enveloping a considerable number of Germans. The British, French and Germans have more than once pierced the enemy trench system; but never before the German drives of this year has there been provided the means to follow up the initial break through on the Western front.

To a German general, Von Hutier by name, remained the privilege of devising a successful method of piercing an enemy front, and then following it up so as to overrun substantial areas and to capture numerous prisoners, guns and other booty in a single tremendous effort. Von Hutier worked out a method which, although credited to him and given his name, appears to be little more than the appropriation on an ambitious scale of the numerous methods and lessons of this war. It is a composite idea, to be sure.

Von Hutier's opportunity to test the efficacy of his method came first in the counterblow against the Russian forces in Galicia during July, 1917, and then in the capture of Riga the following month. Against Russian armies the scheme functioned perfectly, and with the complete collapse of the Moscovite forces Von Hutier turned his attention to the Western front where he was assigned the important rôle of ending the war in a series of unprecedented and brilliant offensives.

There are two essential factors in the Von Hutier offensive: First, there must be a preponderance of men, artillery, and other military resources at the scene of battle; secondly, utmost secrecy must be maintained before the offensive opens, so that the enemy will be taken completely by surprise. The first factor was met, of course, by the betrayal of Russia. Well over a million Germans were released from the Eastern front and brought to the Western, while something like seven thousand guns and vast stores of shell and other supplies were left to the advancing Germans in Russia by the demoralized soldiery of that country. Thus the Germans themselves admitted a numerical superiority on the Western front at the beginning of the year, of at least twenty divisions, and subsequent events indicate that the superiority must have been even greater.

Ever since the autumn of 1914 the contending armies



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French field howitzer of the type now being used by the American Army

have lived and fought in trenches. These trenches, running parallel for the entire length of the front, have prevented any marked mobility of the armies. There have been no flanks to turn, and all attacks have been frontal ones, involving considerable losses for the few hundred yards of territory gained. Strategy has been mostly limited to thinning out certain sections of the line and then forming mobile armies, or "masses of maneuver," for inaugurating attacks at selected points or for repulsing enemy attacks. And realizing that gains could only be made in terms of yards rather than miles, both sides apparently were satisfied and felt safe with a number of parallel trenches to a depth of ten or fifteen miles at the outside.

The second element of Von Hutier's method, surprise, calls for extreme precautions. What with airplanes flying continuously over the battlefront and far into one's territory, it is extremely difficult to hide military activities. Ammunition dumps in the open, new airdromes, new railroads, new roads, hospital bases, troop gatherings —all these things are immediately noted by enemy observers and proper precautions taken to meet the impending attack. Then there are the reports of spies, the declarations of prisoners, and slips of the press which must be watched and prevented from giving information to the enemy. Finally, there is the artillery which, although required to register on the targets before the attack opens, must not betray the heavy concentration taking place.

To prevent the escape of information the German authorities cancelled all furloughs and all correspondence while the March offensive preparations were taking place. The movements of civilians between Germany and the occupied regions of France and Germany were prohibited. The only troops in the trenches were the regular holding troops, since the present German scheme of things is to have second rate troops in the front line, with picked troops or storm troops in the rear held in readiness for attack or defense. The holding troops were without the slightest clue of just when and where the offensive, if any, was to take place, hence could give no information to the British or French in the event of being made prisoner.

The back areas of the German lines were considered sufficiently organized to handle all casualties resulting from the battle, hence no new hospitals were erected to arouse enemy suspicions. The same applied to railways and airdromes and supply bases. Ammunition stores were buried in suitable trenches or in underground dumps at night.

Thousands of guns were brought up to the British front for the offensive of March 21st. These pieces were concealed in woods where possible, and when in the open they were heavily camouflaged. The work of placing them was entirely done at night, so as to escape the eagle-eyed British air scouts. The registering of the batteries was only approximated, and in some instances each gun was only allowed three ranging shots, with several days' interval between shots, so as not to arouse the suspicions of British observers.

Lastly, the German armies destined to deliver the big smash were massed some sixty miles back of the front, whence they could be moved with equal facility to any point between Verdun and the sea. The men and officers were not taken into the confidence of the higher officials, hence nothing could escape concerning their destination. A few days before the attack the troops were moved toward the battlefield by forced marches, all movements being made at night. German airmen

Photo French Official

Forts on wheels during the German offensive: A battery of railway guns mounted in turrets and manned by French sailors much after the fashion of naval practice

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A French howitzer of large caliber and considerable weight, mounted on an iron-wheeled carriage and being hauled to the front by motor truck

Photo French Official

This, as well as headpieces on facing page, shows the French Fillioux gun, which fires its six-inch shells as rapidly as the famous "75"

patrolled the roads over which the German armies marched, in order to detect any suspicious movement or flash of light that could betray the troops. And any units guilty of carelessness were severely dealt with. During the day the troops were quartered in villages or in woods, away from the eyes of chance Allied airmen.

When the intense artillery bombardment opened on the British positions, Von Hutier made extensive use of gas shell, since no great accuracy is necessary with ammunition of that sort. Against the trenches the German artillery fired 60 per cent high explosive shell, 30 per cent sneezing shell, and 10 per cent asphyxiating gas shell. In counter-battery work the Germans fired 70 per cent sneezing, 10 per cent asphyxiating, and 20 per cent high explosive shell. The barrage behind the British trenches, destined to cut off reinforcements, was in the proportions of 60 per cent sneezing gas, 10 per cent asphyxiating gas shell, and 30 per cent high explosive shell. Instead of conducting the bombardment for days, thus giving ample warning of the impending action, the Von Hutier artillery preparation was severe but brief.

The demoralization of British infantry brought about by the intense artillery fire was immediately exploited by the German infantry, advancing to the attack in several waves. The usual rolling barrage fire preceded the first infantry wave. This was less dense than the others, being intended primarily to establish contact with the enemy and then locate the weak spots. The succeeding waves passed through the first wave and through the little groups of British—the so-called "isles of resistance"—still fighting against tremendous odds. Taking advantage of the general chaos caused by the bombardment, the German waves continued to advance as far as possible, through woods, wheat fields, gullies, etc., whenever possible, carrying out that part of the program termed "infiltration." Thus bodies of German troops got behind Allied troops falling back, adding to the confusion of the defenders and seriously interfering with their defense.

Following the infantry waves came support units in column formation with special mobile artillery, particularly *minenwerfer* or trench mortars. During the Riga attack it is known that the Germans made use of over 570 light, medium and heavy *minenwerfer* on a front of only three miles; and so successful did this feature prove that the Germans adopted it on a far larger scale in the Somme offensive. The supporting artillery served to wreck any British defenses which held out against the infantry, and also served to discourage counter-attacks. Last of all came the divisional reserves.

Gas is profusely employed to demoralize the enemy in the Von Hutier attack. In many instances the Germans in the March offensive employed ephemeral gas calculated to evaporate completely by the time their troops reached the spot. But most important of all, however, was the method whereby the Germans exploited the breech, for therein lies the practical value of the great stroke which netted much for the enemy.

Photo French Official

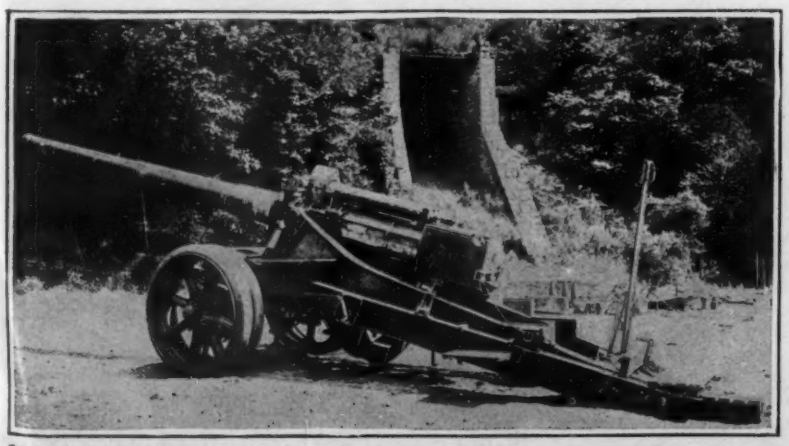
Long-range 305-millimeter gun at the moment of firing. Note the camouflage screens of grass which shield the gun when it is at rest

As the Germans advanced beyond the reach of their artillery they made use of light and heavy machine guns for supporting the infantry. Machine gunners establish barrage curtains, behind which the infantry advances on to new positions. The bulk of the barrage curtain is generally formed by light machine guns and riflemen, while the flanks are held by heavy machine guns which serve to guard against counter-attacks. Thus by a combination of machine-gun fire and short infantry rushes, the Germans continue to advance, making use of every available bit of natural cover, while there follows behind them the units which are to organize the newly gained ground, bring up the heavy artillery, and established the liaison with the rear in the conventional manner.

Such, then, is the Von Hutier method of attack which gave the Germans a fair degree of success on the Somme against the British, in Flanders against the Chemin des Dames held by British and French, against the French and Americans between Montdidier and Noyon, and lastly the recent offensive between Chateau-Thierry and the Argonne foothills, held by Americans, Italians, and French. The last two offensives were not so successful as the Germans expected, due to the fact that the element of surprise was lacking. The Allied command, expecting attacks at the points mentioned, organized a suitable defense days and weeks before the Von Hutier tactics were attempted by the Germans. Indeed, it has been proved that this method, when attempted against almost equal numbers of men and artillery ready for the attack, is far from irresistible.

While little can be said of the Allied method of combating the Von Hutier offensive, it is permissible to state that the attack in depth is met by the defense in depth. Thus in the first place extreme vigilance is maintained against surprise. Then a depth defense is inaugurated, with a front line thinly held by outposts to minimize loss, and successive lines of greater strength extending back for several miles. When the German artillery storm breaks out it is answered by a hurricane of fire from the Allied guns massed to meet the attack. Every point where the enemy might attempt his infiltration tactics, is registered in advance, and during the action these points are plentifully sprayed. Slowly, before the masses of attackers, the defenders give way, falling back through the defensive system which becomes stronger and stronger. Meanwhile the German masses pay a big price for their gain, whereas their heavy artillery fire has been largely wasted on small and scattered outposts. If anything, this method of defense is strongly suggestive of the "pill-box" defensive system organized by the Germans last year during the heavy British and French offensives. The main idea, obviously, is to give the enemy artillery a minimum target of infantry, and then separate the advancing infantry from its artillery support, dealing with it both by concentrated artillery fire and by short, quick counter-attacks under favorable conditions.

(Concluded on page 76)



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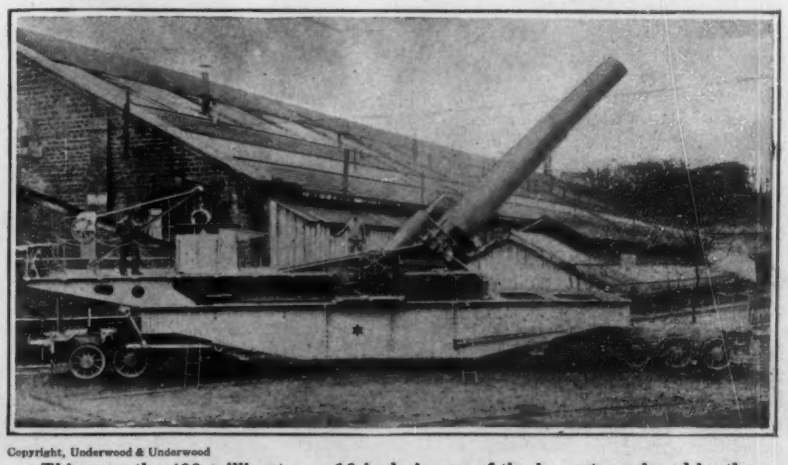
A rubber-tired, highly-mobile quick-firing gun employed by the French army for meeting German offensives



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This gun, the 400-millimeter or 16-inch, is one of the largest employed by the French heavy-artillery batteries

The Heavens in August, 1918

The Nova and the Eclipse Brought Down to Date

By Prof. Henry Norris Russell, PH.D.

THE great new star in Aquila, of which we spoke last month, is still visible to the naked eye, though as a mere ghost of its initial glory. Its decline in brightness, at first very rapid, carried it down to the magnitude 3.8 on June 29th, rather less than one per cent of its maximum brightness. Within the next few days it brightened up again to third magnitude; since then it has, on the whole, faded, but much more slowly, its magnitude at present being about 4.0. Its variation so far has been very similar to that of Nova Persei of 1901, the only other really brilliant new star of modern times; and, with this as a guide, it should remain visible to the naked eye for some weeks to come.

It has already been told how the present Nova was found on many photographs taken before the outburst, as a star of the tenth or eleventh magnitude. Its position in the heavens was accurately determined some years ago on the plates of the photographic *"Carte du Ciel"* and from a comparison of these with other observations, Trumpler, a Swiss astronomer now at the Allegheny Observatory, has found that the star has a small, but unquestionably real, proper motion, of two seconds of arc per century. This is much smaller than the average for the stars visible to the naked eye, and would not be large for a star of tenth magnitude.

The proper motion of Nova Aquilae is almost in the direction of the drift which it would appear to have, owing to the sun's motion in space, if it were really at rest. On the latter assumption, the distance of the star would be about three hundred light years; but such an assumption, in such a case, would be without warrant. The real distance of the star may be much less than the figure named, or much greater, with the odds rather in favor of the second alternative.

Even this crude estimate, however, is enough to show that it must have been extremely bright at maximum. If at the assumed distance, its brightness before the outburst would have been half that of the sun, and at the maximum about thirty thousand times as great as the sun's. Though this last estimate may be too high, it seems most improbable that the star should be so near that its greatest light was less than a thousand times that of the sun; and it may well have been even greater than the larger figure given above.

The spectrum of the Nova, at first roughly resembling that of Sirius, with dark lines of hydrogen, changed within a few hours to the typical "new star" spectrum, with broad bright bands. This change took place while our side of the world was turned away from the star and toward the sun, during the daytime on June 10th. We can, therefore, only hope that some watcher in Japan, Australia or India, warned by the appearance of the brilliant newcomer two days before, was observing it through this rapid transition.

From the Mt. Wilson Observatory comes the remarkable news that many of the dark lines in the spectrum of this star are identifiable with lines in the spark spectra of iron, titanium, and other metals, but all displaced from their normal positions by an amount which, if due to motion in the line of sight, would demand for its explanation the enormous velocity of 1,500 kilometers, or more than 900 miles, per second. What the real meaning of this extraordinary displacement of the lines may be must await further study.

The June Eclipse

News is beginning to come in, too, from the solar eclipse of June 8th. The fullest account yet published is that by Professor Campbell of the Lick Observatory. This veteran observer had a series of vicissitudes which were probably unequalled even in his wide experience. The best "eclipse instruments" of the Lick Observatory were left in Russia after the eclipse of August, 1914, when the first conflagration of the Great War made their return to America impossible, and that of the observers themselves difficult, if not actually dangerous. After long delays they were fortunately removed to Vladivostok before the outbreak of disorder in Russia, and later they reached Japan; but they did not cross the Pacific in time for the eclipse. However, enough instruments remained at the Observatory to fit out a well equipped expedition; and this proceeded to Goldendale, Ore., where it established itself with characteristic care and thoroughness.

But the eventful Saturday dawned with the sky "completely covered with clouds of medium thickness" and the prospects for observation were apparently hopeless. But almost at the moment of totality fortune changed. "A very small area of blue sky free from clouds had the sun at its center exactly at the middle of the total phase, and all other parts of the sky were clouded. This region cleared not more than a minute before the beginning of totality, and clouds again covered the sun less than a minute after the passing of the shadow."

It speaks well for the diligence and indomitable perseverance of the party and its leader that "all of the instruments and all of the observers were ready, and the program went through as planned." The corona was unusually brilliant, and showed a more elongated outline than has been usual so near the time of sun-spot maximum. The streamers extended two and a half solar diameters to the east and west, but scarcely more than one diameter to the north and south of the sun. The solar prominences were numerous and conspicuous, and the arching of the corona streamers around the prominences left no doubt that the forces which produce the latter control also the former. Many photographs were made of the corona and the stars in the vicinity of the sun; but it will be some time before the results can be studied.

Professor Campbell's many good friends will rejoice at this remarkable bit of fortune—and it is more than probable that they will see, too, a close connection between the qualities of the leader of the expedition which was so perfectly prepared that it could snatch success literally in a moment from apparent hopeless failure, and those of his son—the Lieutenant Campbell who has more than once been mentioned in the despatches from the western front as the first American "ace."

The Heavens

Turning to our map, we find the great cross of Cygnus right overhead. The line of its foot points down the Milky Way, past Aquila and the new star, to Ophiuchus. Scorpio, which is now setting, and Sagittarius are well up in the southwest. Carried in the opposite direction through the bright star Deneb at the head of the cross, this same line leads to Cepheus, Cassiopeia and Perseus, low in the northeast. The transverse arm of the cross (the wings of the swan) points northwestward to the head of Draco, and beyond to the tail of the Great Bear; while toward the southeast it passes to the right of the great square of Pegasus, and down into the almost empty region toward Cetus. Andromeda is well up in the east, and Aries and Pisces have risen, lower down. Aquarius and Capricornus are in the south and southeast, with the Southern Fish and its bright star Fomalhaut below. The finest constellations of the rather dull summer skies are in the west—Lyra very high, Hercules and Corona below, Bootes near setting.

At 12 o'clock: Aug. 7.
At 11½ o'clock: Aug. 14.
At 11 o'clock: Aug. 22.

At 10 o'clock: Sept. 6.
At 9½ o'clock: Sept. 14.
At 9 o'clock: Sept. 21.

At 10½ o'clock: Aug. 29.

The hours given are in summer months time

NIGHT SKY: AUGUST AND SEPTEMBER

The Planets

Mercury is an evening star this month, and is well visible about the time of his greatest elongation on the 5th, when he sets a bit after 9 P. M., summer time. As time goes on he draws southward and nearer the sun, and before the end of the month he is lost to sight.

Venus is still a morning star, rising at about 4 A. M. by the clock in the middle of the month and, as always, she is brighter than anything else in sight.

Mars is an evening star in Virgo, setting at about 10.30 in the middle of the month.

Jupiter is a morning star in Gemini, rising at 3.10 A. M. on the 1st and at 1.40 on the 31st.

Saturn is in conjunction with the sun on the 11th, and is invisible.

Uranus is in opposition on the 19th, and therefore well visible. He is in 21h. 53m. R. A. and 13° 40′ south declination, which places him on the border of Capricornus and Aquarius, about 45′ east and 15′ south of the fifth magnitude star *μ Capricorni* (which is itself 2½ degrees north and 1½ degrees east of the bright star *δ Capricorni*). The planet is moving slowly Southwest, and by the middle of September will be directly south of *μ Capricorni*) at a distance of about eight minutes. The neighborhood of this star, which is about twice as bright as the planet, will make it very hard to see the latter with the naked eye—a difficult feat at any time—but very easy to pick it up with a field glass.

Finally, Neptune is just past conjunction with the sun, and is hopelessly minute.

The moon is new at 4 P. M. on the 6th, in the first quarter at 7 P. M. on the 14th, full at 1 A. M. on the 22d, and in her last quarter at 3 P. M. on the 28th. She is nearest the earth on the 23d, and farthest away on the 11th. She is in conjunction with Jupiter on the 3d, Venus on the 4th, Neptune on the 6th, Saturn on the 7th, Mercury on the 8th, Mars on the 12th, Uranus on the 21st, and Jupiter again on the 31st. Most of the observable conjunctions are close.

Washington, D. C., July 15th, 1918.

The Current Supplement

POWER for the many ships that we are building at present is a serious problem, and this has greatly stimulated the general interest that already existed in regard to the use of internal combustion engines for marine purposes, a use that can hardly be said to have yet altogether progressed beyond the experimental stage. Under the circumstances the paper on *The Heavy Oil Engine*, by one of the leading American authorities on the subject, in the current issue of THE SCIENTIFIC AMERICAN SUPPLEMENT, No. 2221, for July 27th, is most timely, particularly as it discusses not only present conditions of development, but makes many valuable suggestions in regard to future improvements. *Why Water Over-Fills a Tumbler* treats of a curious physical phenomenon, closely related to the must discussed ore-flotation process. It is illustrated by photographs and drawings. *A Home-Made Telescope* describes how any amateur astronomer can easily construct a very serviceable instriment, at a minimum cost, that makes a surprising range of observations possible. *Big Things in Steel* gives some insight into the work done in some of our great works, and is accompanied by a number of excellent photographs. The paper on *Electrolysis Mitigation* is concluded in this issue. *Radiation and the Electron* considers important physical questions that are attracting wide attention, and which lie at the foundation of modern physical theory. *The Possibilities of Powdered Coal* deals with methods for the more efficient utilization of our fuel supplies that are attracting general attention. Other articles of interest are *Insects Helpful to Man*, and *The Fabricated Ship*.

Catalogue of Nebulae

A NEW catalogue of nebulae has been published by M. Bigourdan, of the Observatory of Paris. This publication gives the results of the author's micrometric measurements of nebulae from 1884 to 1911. Of the 6,000 nebulae discussed in the work, 500 are new, bringing the total number of catalogued nebulae up to 15,000.

Opening a New Link of New York's Vast Subway System

Difficulties of Converting a Tunnel Into a Bridge Without Interrupting Traffic

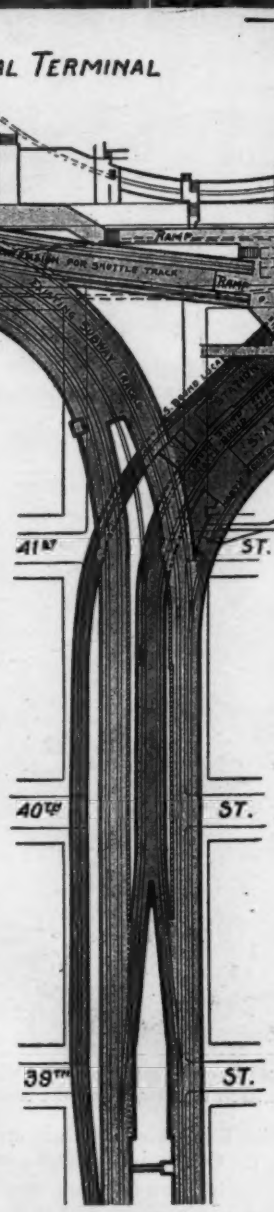
One of the huge girders carrying the old subway and supporting the roof of the new

Three drifts extending from the Grand Union plot under the old subway

THE opening of the Lexington Avenue branch of the New York Subway line last week marked the culmination of one of the most difficult engineering problems ever carried out in New York city. At present, only the local tracks are in service from Forty-Second Street to 167th Street on the Jerome Avenue line. In a week or two, it is expected that the express service will also be installed, and then trains running up the present Fourth Avenue line, instead of crossing the city at Forty-second Street and proceeding up the Broadway line, will travel up Lexington Avenue. At the same time, trains coming down Broadway above Forty-Second Street will turn at Times Square into Seventh Avenue and proceed downtown on the west side of the city. Connection between the East and West Side lines will be maintained by a shuttle service across Forty-second Street. This will form the horizontal bar of the so-called "H" system.

The intersection of Forty-second Street and Park Avenue will thus become one of the most important traffic centers of the city; for here we have the junction of the Lexington Avenue line with the Forty-second Street shuttle, and on a still lower level there is the Queensborough tunnel. While overhead, there is a branch of the Third Avenue Elevated Railway, with another flow of traffic furnished by the New York Central and the New York, New Haven and Hartford Railroads at the Grand Central Terminal.

In the SCIENTIFIC AMERICAN of July 17th, 1915, we described in detail the engineering work involved in diverting the existing subway from its present course to Lexington Avenue. The accompanying drawing gives a general idea of the arrangement of tracks and platforms at this important junction. The new subway tracks branch off from the old in the region of Thirty-ninth Street, where they run down grade until they have acquired sufficient headroom to pass under the old subway tracks, and branch off toward the east, except for the north bound local, of course, which turns off without passing under the existing tunnel. Here a new station has been built, which is locally known as the "Diagonal Station" because it runs diagonally from Forty-first Street and Fourth Avenue to Lexington Avenue north of Forty-second Street. A large part of the station is built in an open excavation where formerly stood



Junction of three subway lines at 42d Street

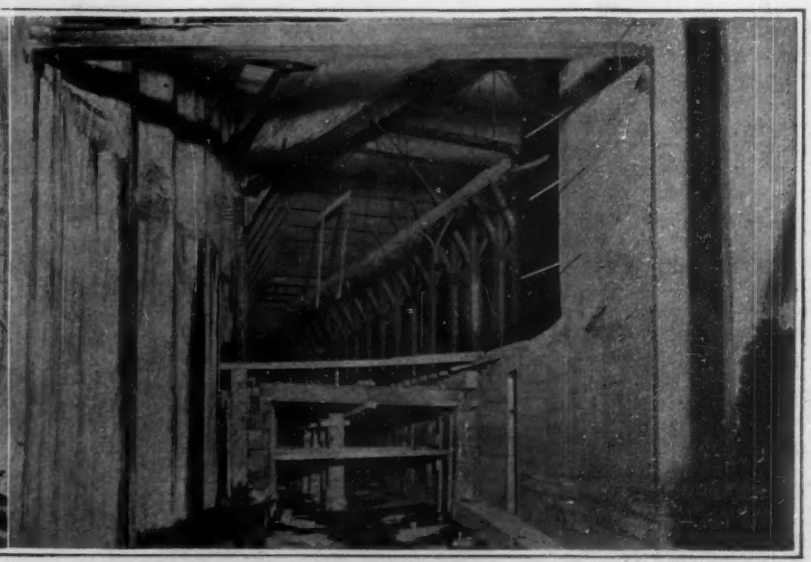
the Grand Union Hotel, and this open plot provided a vantage point from which the new tunnels were pushed under the existing subway line and connected with them. It will be recalled that above the subway on Park Avenue there is another tunnel through which run the street cars. So that, altogether the rock at this point is fairly riddled with tunnels—in fact, it has earned for itself the name of "the honeycomb."

As shown in the drawing, the northbound tracks of the existing subway run under the east side of Park Avenue and are separated by a core of rock from the tunnel in which the southbound local and express tracks run. A tunnel for the new north and south bound express tracks has been cut through this core of rock between the tracks of the existing subway. It was an exceedingly difficult task to cut away the core of rock between the north and south bound tunnels of the old subway without precipitating a slide upon the work. In this region the rock is very poor indeed; it is full of slanting seams. Some of the rock is very hard, but much of it is soft with large pockets of disintegrated rock. This is so soft that on exposure to the air for a few hours it may be broken off with the fingers and pulverized in the hand. No reliance whatever could be placed upon the stability of the rock to support the roof, while the operations were proceeding. The problem was to cut away the inner half of the arch of each existing tunnel and remove the core of rock between them without interfering with the heavy traffic at this point. When it is realized that during the rush hours there is a train passing on one of the four tracks every thirty seconds and that in the neighborhood of a million passengers go over this line each day, the hazardous nature of the work will be appreciated. The slightest mishap might have precipitated an appalling catastrophe. The tunnels were first lined with a sheathing of timbers to prevent materials from dropping down upon the cars. Then the core of rock was removed by the nibbling process so that there was little unsupported rock at any one moment.

One of the most interesting bits of work was that of passing the new subway under the old. Here the existing subway had to be changed from a tunnel to a bridge. It was necessary to support the old subway upon a system of girders which would also carry the roof of the new

(*Concluded on page 76*)

A line of girders in the old subway. Note that the sheathing at the right has been removed to admit one of the big girders



Where the new north-bound local meets the old. The grade of the existing line must be lowered so as to run into the Diagonal Station

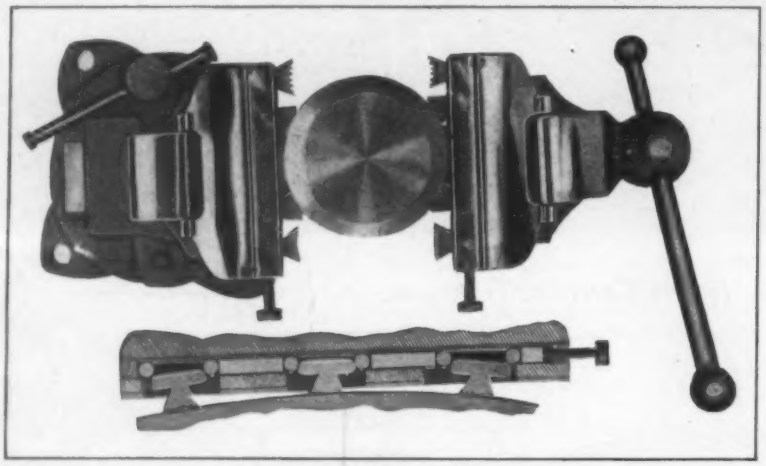
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Exerting an Even Pressure on Irregular Surfaces

WHAT is claimed to be an entirely new application of a mechanical principle, has been recently made in the construction of an attachment for a vise by which the latter may be made to take a firm hold on all irregular surfaces and shapes. No matter what the lines of a piece of work may be, equal pressure is exerted throughout its length and it is firmly secured in the jaws of a vise supplied with this equalizing device. This will save much time in shops where in order to handle irregular shapes the men are called upon to make blocks to equalize the pressure of the jaws so that the piece may be held securely while being worked.

According to the manufacturers, the mechanical principle may be likened to a number of round balls resting in a row, slightly off center. When the pressure is applied to the end balls, all of the others will move out of line in opposite directions. Thus by arranging a number of lugs in opposite directions, with curved contracts on a channel, these lugs will act as compensating wedges and force the gripping lugs to protrude from the channel and automatically equalize any pressure which may be applied.



A new type of grip for the vise

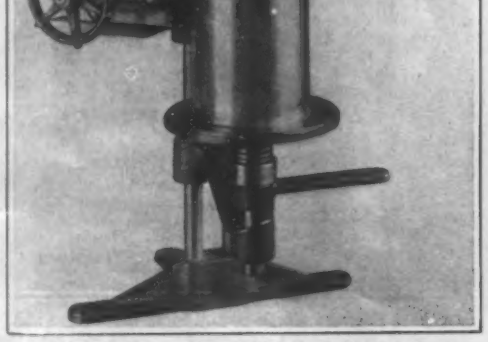
The article to be held is placed in the vise and the jaws brought together and then a few turns of the exposed screw heads of the device bring all the lugs in equal contact, after which a slight additional turn on the vise handle is given and the grip on the object is absolute. The principle involved in this invention has been applied to the locking up of printer's forms and here it will also be the means of saving much time. The system now generally in vogue requires the workman to make several adjustments to each of many quoins before getting the form locked up securely. The new method calls for manipulation at two points only and a tremendous pressure is distributed where required throughout the chase by screw pressure. It provides a straight edge next to the form which is always locked up perfectly true.

Sanitary Can and Sealing Machine

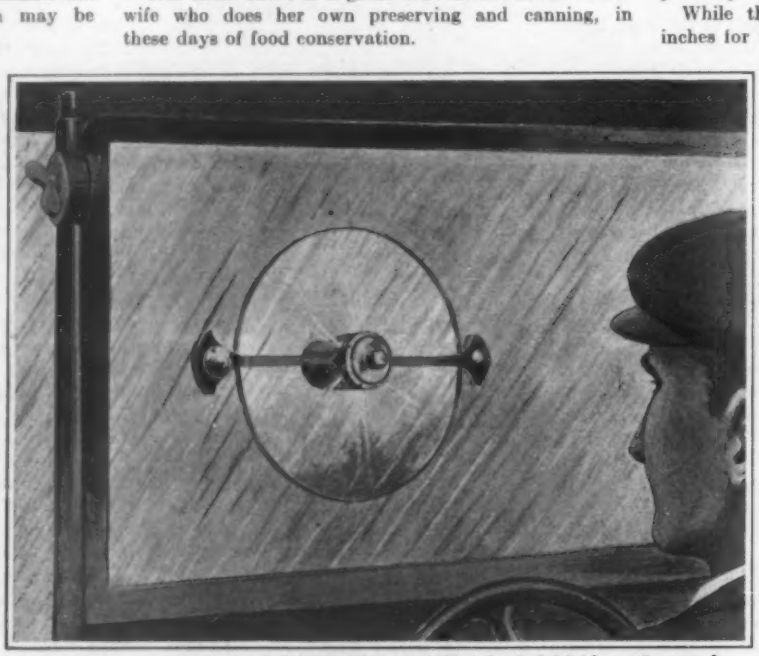
THE new can for putting up fruit and vegetables will be appreciated by the housewife who likes to have her table look pretty. Fruits and vegetables can be packed in these can without cutting, such as large tomatoes and peaches that would not go into the old-style cans. The can is open entirely so that the packer can see just how the can is being filled and can arrange her fruit to the best advantage.

A sealing outfit goes with these cans which quickly and easily closes the cans without the use of solder. The entire cover is off when the can is received. It is full size and has a rim bent down to hook up under the flange of the top of the can body in such a way as to form a tight joint without the use of solder. The covers are lined with a gasket or preparation to make the joint doubly sure. The sealing operation is quite simple. The can when filled is placed on the can base of the sealer machine which is grooved to fit the bottoms of different sized cans. A lever below this base is turned to the right, raising the can against the sealing chuck and pressing the cover down tightly on the can. Another lever is turned which rotates the can and the sealing rolls are brought against the rim of the cover by turning the small hand wheel, first one way and then the other. The first roll curls the can cover up under the edge of the can body and bends the flange of the can body down into the bend of the cover. The second roll squeezes the seam tight so that it will sustain over twenty pounds of pressure. This makes an airtight joint.

This little outfit is a great convenience to the housewife who does her own preserving and canning, in these days of food conservation.



Machine for sealing fruit cans in the kitchen



At the command of a push button, this centrifugal windshield revolves and clears itself of snow, rain, mist or dust

Clearing the Windshield of Rain and Snow by Centrifugal Action

NOT contented with the numerous methods of keeping the automobile windshield clear of rain and snow and other things which interfere with the visibility of the driver, an inventor has lately developed an ingenious centrifugal form of windshield based on the centrifugal principle. While it is simple in construction and readily applied to any existing windshield, it apparently "does the trick," to use a good colloquial expression.

The centrifugal device, it will be noted in the accompanying illustration, consists essentially of a plate-glass disk revolved at a high rate of speed by a small electric motor. The disk is inserted in a hole of slightly larger diameter, in the windshield, leaving but a small clearance. The speed of the revolving disk is 2,000 r. p. m., and by the use of fine ball bearings a tiny motor is sufficient for the work in hand. Current for the motor is provided by the usual battery of the automobile, and the designer claims that the windshield device costs less to operate than a single headlight. Obviously, the centrifugal windshield does not have to be operated continuously, and to this end a push button installed in a convenient place on the regular instrument board is used to control it. Whenever the windshield becomes covered with rain, snow, sleet, mist or dust, the push botton is pressed, and instantly the circular plate in front of the driver is perfectly clear.

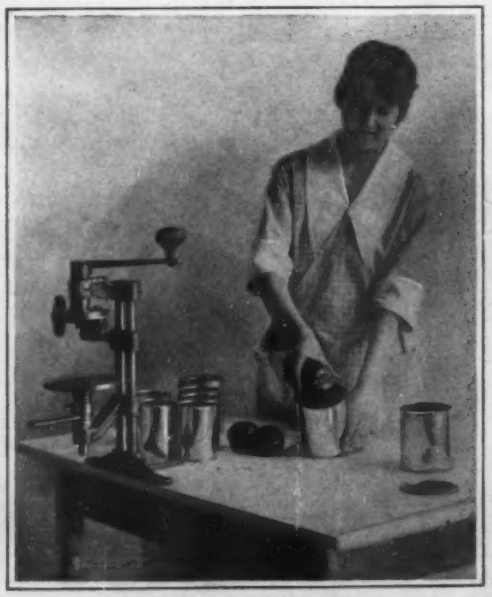
While the standard-sized plate-glass disk is seven inches for use on automobiles, the makers are ready to supply larger disks and equipment for use on street cars, airplanes, battleships and wherever else such a device is now needed to ensure clear sight at all times.

Enemy-Owned Patents

THE Trading-with-the-Enemy Act provides that any person in the United States who holds or has custody of any property of, for, or on behalf of an enemy or ally of an enemy, or who is indebted to an enemy or ally of an enemy, or to any person whom he may reasonably believe to be such, shall make report of this fact to the Alien Property Custodian.

It is estimated that there are over a thousand enemy owned or controlled patents used by manufacturers in the United States that are earning royalties or fees of some kind for enemies. Less than one-fifth of them have been reported to the Alien Property Custodian. This means that 800 persons, inventors, manufacturers, agents, holders or licensees are making themselves liable to the penalty of $10,000 fine or 10 years' imprisonment or both.

If the persons using these patents will not report, it becomes the duty of loyal and patriotic citizens to do so, or at least to send in information on which the Government may proceed. At the request of the Custodian, the SCIENTIFIC AMERICAN takes this opportunity to call the provisions of the Act to the attention of all concerned, and to urge them to coöperate in causing reports to be made of patents, royalties, or other property or debts coming within the provisions of the Act. In case of doubt, the facts should be reported and the Alien Property Custodian will make whatever investigation is necessary.



The home canner in operation

Price Fixing Contracts on Patented Articles

By E. B. Marshall

IN the recent case of Boston Store of Chicago vs. American Graphophone Co. and Columbia Graphophone Co., the United States Supreme Court has again gone over the questions which have been repeatedly raised as to the right of a patentee who delivers his patented article to another for a gross consideration then received, to reserve by contract a part of his monopoly right to sell. This question has been presented to the Courts in various ways each time in the hope that with some change in

(Concluded on page 77)

Westinghouse

"No Noise in *These* Gears"

Take Bakelite Micarta Gears of any size, run them at any speed, and you will find them always practically free from noise.

That's because Bakelite Micarta Gears are non-metallic, and it is the play of metal against metal that makes metallic gears noisy.

Even at the sacrifice of wear-resistance, it would pay to replace metal with Micarta Gears. By reducing noise, they increase efficiency among the workers, while, as a part of the product itself, their silent operation is frequently a most important advantage.

Micarta Gears, however, mean not shorter but longer gear life. Meshing non-metallic with metallic gears greatly reduces the wear of the metal gear.

Moreover, Bakelite Micarta under average conditions, will last as long as untreated steel or bronze. It will usually outwear forged steel where sand or grit are present.

Micarta Gears have many features found in no other non-metallic gears.

They are self supporting and, in most cases, require neither bushings nor flanges.

They will run in oil without swelling.

They will not absorb water.

They are never attacked by rodents.

They are not affected by acid or alkali solutions.

As Micarta Gears are self supporting and do not need shrouds or end plates except where requirements are unusually severe, they can be used where other non-metallic gears can't be.

Where They Can Be Used

Westinghouse Micarta Gears can be substituted for untreated steel, cast-iron, bronze, raw-hide or other non-metallic gears, in a large majority of commercial applications.

This has been demonstrated by actual service in a wide variety of applications, including many of great severity.

Westinghouse engineers will gladly consult with you or your engineers as to how you can benefit by the use of Micarta Gears.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

Bakelite-Micarta Gears and Pinions

RECENTLY PATENTED INVENTIONS

Pertaining to Apparel

METHOD OF WEAVING GARTER PADS.—W. ACHTSERTER, 29 Wade St., Middletown, Conn. The invention relates to garters having a pad or shield from which extends a leg encircling band and a horse clasp. The object of the invention is to provide a method for producing a woven garter pad in one single piece, and which pad is exceedingly strong and durable, neat in appearance and readily and accurately fits itself to the wearers leg.

Electrical Devices

SOUNDER FOR TELEGRAPH CIRCUITS.—F. E. SMITH and LE ROY HEFLIN, care of D. Lafe Hubler, Fairfax, Okla. An object of the invention is to provide a main line sounder which obviates the necessity of a local circuit. A further object is to provide a device with all the features of a loud sounder, while at the same time retaining all the quick adjustment features of the standard relay. A still further object is to provide a sounder having two sets of coils and two armatures, the coils being connected in series and the armatures being connected so that they work synchronously, the force of one magnet being added to that of the other.

AUTOMATIC SWITCH.—G. F. HAMMOND, Montecito, Cal. This invention relates particularly to the control of one switch station from a distant control station, so that power may be turned on and off at the first station without, requiring the services of a control operator at

A SIDE VIEW OF THE SWITCH MECHANISM

that point. Briefly the invention includes a mechanical switch arrangement having electrically operated controlling means whereby the movements of the mechanical parts into and out of operative relation may be controlled from a distant point through the electrical feature.

Of Interest to Farmers

CULTIVATOR SHOVEL.—V. DANIELS, Geneseo, Ill. The invention relates generally to ground working implements, and more particularly to cultivator shovels, the object being to provide a shovel constructed in such manner as to allow for free passage and clearance of the broken soil, and one which will at the same time be extremely strong in spite of its divided upper portion. A further object is the provision of effective connecting means between the upper divided portion and the cultivator beam to which the shovel is attached.

PLOW.—G. BLEDSOE, Clinton, N. C. The invention relates more particularly to an implement for preparing the soil for receiving the grain and for cultivating after the seed has germinated. The invention consists of a beam, a runner having rigid connection with the beam, a standard pivotally connected at its lower end to the runner, and adjustably connected at its upper end to the beam, and a blade attached to the standard and adjustable therewith for varying its pitch according to the nature of the work and character of the soil.

DISK SHARPENER.—W. C. HOPPES, Dawson, Neb. The invention has for its object to provide a machine of the character specified by which disks used in cultivators, harrows, and the like may be sharpened, the disks and the grinding wheel being yieldingly mounted and spring-pressed toward each other for the purpose; the supporting frame for the grinding wheel and the disks is adjustable.

Of General Interest

CANDLE WICK SUPPORT.—A. G. BULLE, address, C. H. Pattengell Corp., 80 Wall St., New York, N. Y. The invention has particular reference to that type of candle known as night candle calculated to burn for a definite length of time and then burn out. Among the objects is to provide a support for the wick, the candle being ordinarily molded or formed without a wick, but with a hole through which the wick is introduced into operative position.

CLASS ROOM SANITARY WARDROBE AND BLACKBOARD.—F. B. MILLER, Central Trust Bldg., Jefferson City, Mo. An object of the invention is to provide a wardrobe, the front of which is in the form of one or more blackboards mounted to turn on a central vertical axis, whereby the back of a blackboard section may be employed for supporting garments, the blackboard sections being independently or simultaneously opened by means of simple mechanism.

DEVICE FOR WRAPPING OR FORMING CIGARETTES.—R. M. SKEELS, 211 Delaware Ave., Buffalo, N. Y. An object of the invention is to provide a cigarette roller including an inner tube, an outer tube and a forming band or strip adapted to co-act in compressing a portion of loose tobacco and rolling a cigarette paper around the tobacco for forming a cigarette, the device is simple in operation, durable and inexpensive to manufacture.

CALENDAR.—T. R. TAMMEN, Parkersburg, Iowa. The object of the invention is to provide a daily calendar of the perpetual type, comprising a casing having a single opening, and pockets extending longitudinally thereof, slides adjustably mounted in the pockets, containing indicia representing the days of the week and month of the year, and a chart for vertical and horizontal adjustment of the slides.

BUTTON.—J. A. SEBENIUS, Sheldon, Wash. The invention has for its object to provide a button consisting of separable sections which may be arranged on opposite sides of the material to which the button is to be attached, and connected together through the said material. The inner

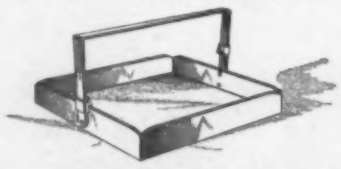
A VERTICAL SECTION THROUGH THE BUTTON

section of the button is placed in position, and the pointed end of a threaded pin forced through the material of the garment, the outer section is engaged with the pin and threaded tightly towards the inner section, and the material clamped firmly between the teeth of the sections.

GASOLINE AND OIL FILTER.—G. CAEN, Sr., 415 Live Oak St., San Antonio, Texas. The invention has for its object the provision of a device for freeing soiled gasoline, oil and the like from impurities, and putting the said products into condition for reuse. The device comprises a filter with inner and outer cylinders of porous carbon, the top of the cylinders being closed. The oil or gasoline passes through the outer and inner cylinders into a space where it may be drawn off.

EGG SHIPPING PACKAGE.—J. M. HARR, Washington, D. C. This invention consists of a series of superposed cell structures formed of partitions intersecting at right angles, of dividing and cushioning members consisting of an elastic plate having a series of registering openings with surrounding elastic fingers, and intersecting hollow ribs extending around the openings provided at their angles with struck-up protuberances that project from the plane of the ribs.

TRAY.—S. G. SINGLETON, P. O. Box 911, Burke, Idaho. The invention has for its object the provision of a device especially adapted for bakers' use, wherein the tray has a handle which

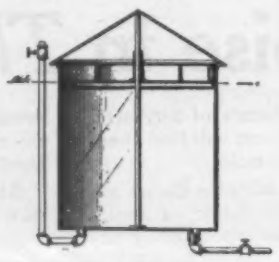


A PERSPECTIVE VIEW OF THE TRAY

may be swung down into the plane of the tray or into a position perpendicular to the tray to facilitate the handling of the tray and to support a protecting screen for the tray; the handle may be locked in the desired position.

RACK.—C. M. RAY, Asheville, N. C. The object of the invention is to provide a device especially adapted for printers' use, wherein the rack consists of a fixed portion having means for securing the same to a table, with the fixed portion in inclined position, and a movable portion hinged to the fixed portion, the portions having means for holding the movable portion in alinement with the fixed portion or in horizontal position, and a tray connected with the movable portion and on the top thereof, when the said movable portion is in horizontal position.

OIL TANK.—W. MACPHERSON, 138 Ohio Ave., Wichita, Kans. The invention has for its object to provide an oil tank which is fitted with a floating inside cover adapted to rise and fall



A VERTICAL SECTION THROUGH A TANK FITTED WITH THE DEVICE

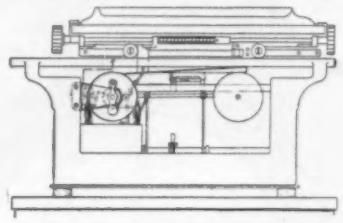
with the oil as it varies in level, to prevent the access of air to the surface of the oil. The floating cover consists of upper and lower disks which are flanged inwardly; the disks rise and fall on a central bearing.

CLEVIS.—B. TALKINGTON, Harrington, Wash. An object of the invention is to provide a simple construction whereby to do away with the use of pins extending through one or more of the parts to be connected with their resulting projecting ends, and to avoid projections of any such nature as are likely to catch and retain passing parts or materials. A further object is to provide a clevis the parts of which are so formed as to be capable of twisting and bending so as to adapt the same to form a complete connection with but a single pair of connecting links.

CALENDAR SUPPORT.—G. A. TUCKFIELD, Independence, Mo. This invention has for its object the provision of a device wherein a suitable support is provided having its upper surface inclining downwardly toward one end, and having means at the other end for supporting a roll of paper, and means on the upper face for guiding the strips of paper, the guiding means adjacent to the roll support carrying a mounting for a calendar support.

AIMING DEVICE.—G. A. BRODSTROM, care of J. B. Barrett, 804 Duke St., Alexandra, Va. The invention has for its object to provide a device, for use with guns, for acquiring accuracy in aiming without the expenditure of ammunition. In use the muzzle of the rifle rests on the instructor's shoulder, the rifle being held by the person being instructed. The person being instructed aims through the sight and gives directions to the instructor for moving the target until the person instructed is satisfied that the sights are alined on the target, the instructed is then directed to puncture the card, the marking on the card showing the accuracy of the aim.

TYPEWRITER ATTACHMENT.—E. P. C. LOMAS, Box 71, Butte, Mont. The object of the invention is to provide mechanism in connection with the usual typewriter for automatically returning the carriage at the end of its movement



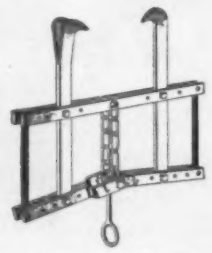
A REAR VIEW OF TYPEWRITER PROVIDED WITH THE ATTACHMENT

during writing, wherein a spring motor is provided, wound and tensioned by the movement of the keybars on their striking movement, and wherein means is provided for restraining the operation of the motor until the end of the line is reached. A further object is to provide trip mechanism operated by the carriage at the end of its movement during the writing for tripping the restraining means for the carraige returning mechanism.

Hardware and Tools

HINGE.—B. J. SCHWAB, 414 S. Nickel Ave., Miami, Ariz. The invention relates to hinges for window shutters, the object is to provide a device which may be connected to the window to permit the shutter to swing outwardly into open position, to act in the nature of an awning, or to swing inwardly into closed position to prevent the entrance of dust, insects and the like; means is provided in connection with the hinge for permitting the easy removal of the shutter without detaching the hinge.

GRAPPLE.—C. E. DREILING, 735 Center St., Henderson, Ky. The invention has for its object to provide a device which may be engaged with a fixed object, as for instance a beam, joist,

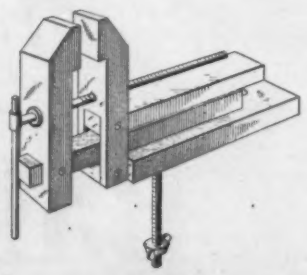


A PERSPECTIVE VIEW OF THE GRAPPLE

log or the like, and clamped thereto and in which the strain of the grapple will tighten the grapple on the fixed object. The device consists of a pair of gripping dogs, one being forked at one end the other having a single spur. Each dog is pivoted intermediate its ends between a pair of bars by means of a bolt and nut, the pivoted connection being adjustable.

CUTTING DEVICE.—T. C. PRUETT, 318 Earle St., Covington, Ky. The object of the invention is to provide a device, especially adapted for cutting the wrappers from newspapers, periodicals, packages and the like, wherein a shoe is provided adapted to run beneath the wrapper and to be attached to the cutting blade which will cut the wrapper as the shoe moves along. The device may be used in connection with the blade of an ordinary penknife, by arranging the back of the blade in contact with the shoe.

VISE.—T. J. CRAWFORD, 222 Joliet St., Ottawa, Ill. The invention relates to a light compact vise of wood, which may be easily trans-



PERSPECTIVE VIEW OF THE VISE

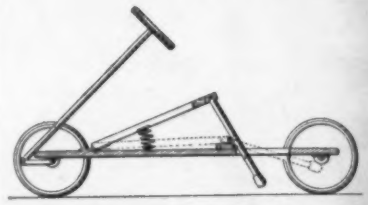
ported by the user, and which may be placed in position upon a temporary bench by means of one bolt and nut. The jaws may be tightened by means of a screw and handle, the vise is of wood, with the exception of the screw, ratchet, catch and spring.

Heating and Lighting

BOILER.—W. H. CAHILL, 317 E. Colorado St., Racine, Wis. An object of the invention is to provide a steam boiler of the water tube type in which the formation of scale in the water tubes is reduced to a minimum. A further object is to provide a boiler with headers at opposite ends, one of the headers having a larger inlet into the steam drum than the outlet from the drum into the other header, the purpose of this being to provide for the additional volume of steam generated while the outlet only has to take care of the water. Provision is made that the surface scum in the steam drum may be easily drawn off together with the sediment which has been deposited.

Pertaining to Recreation

CHILD'S COASTER.—L. E. GARTLEY, 806 W. 9th St., Coffeyville, Kans. The object of the invention is to provide a device wherein a wheeled vehicle is provided, having means for guiding



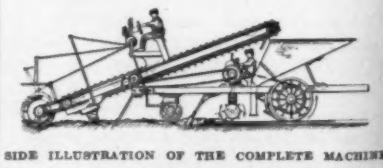
A LONGITUDINAL SECTION OF THE COASTER

the same, and having means in connection therewith for pushing the vehicle, operated by the occupant. The user stands upon the top of the coaster with one foot upon a plate, and at regular intervals depresses the same, a rod moving downwardly brings a shoe in contact with the ground to move the vehicle forward, because of the inclination of the rod.

Machines and Mechanical Devices

SUBGRADE SCRAPER.—E. G. CARR, care of Milwaukee Concrete Mixer Co., 955 30th St., Oakland, Cal. The object of the invention is to provide mechanism adapted to run upon the header boards or forms and to cut away the surface of the grade, and wherein the cutting blades may be adjusted to any desired depth, and means is provided for permitting the scraper to be turned without the necessity of removing it from the roadway.

ROAD MAKING MACHINE.—M. N. LATTA, Valentine, Neb. This invention relates generally to road making apparatus, and more particularly to roadway machines for forming roadways with the material directly at hand, where good horse roads are difficult to make, the general object being the provision of a machine movable along a

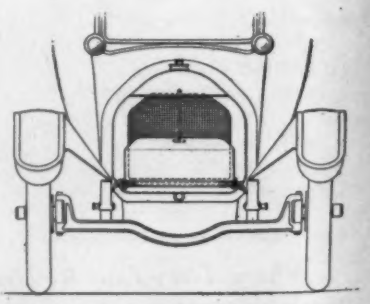


SIDE ILLUSTRATION OF THE COMPLETE MACHINE

selected roadway site, capable of the formation of wheel tracks in the course of its movement. A further object is to provide a machine capable of ready adjustment and interchange of parts for other purposes, for instance it can be transformed into a freight car in a very short time. For the grading of roads the machine is self-loading and self-adjusting, automatically throwing the high side to the low side, whether at left or right.

Pertaining to Vehicles

COVER FOR RADIATORS.—F. M. COCKRELL and J. M. ROCKWELL, 203 Brown St., Liberty, Mo. This invention relates to a protective cover for radiators of automobiles, whereby to conserve the heat thereof in cold weather and to aid in maintaining the water at the proper



FRONT ELEVATION OF AN AUTOMOBILE COVER, WITH INVENTION APPLIED

temperature. More particularly the invention relates to a curtain arranged to wind upon or be unwound from a spring roller, the curtain being adapted to close to any desired extent a front opening formed in the cover.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee title of the invention, and date of this paper.

Reflecting the Ideal Behind Harrison Radiators

THE new Harrison plant is now at your service—buildings and machinery complete, down to the very last bolt.

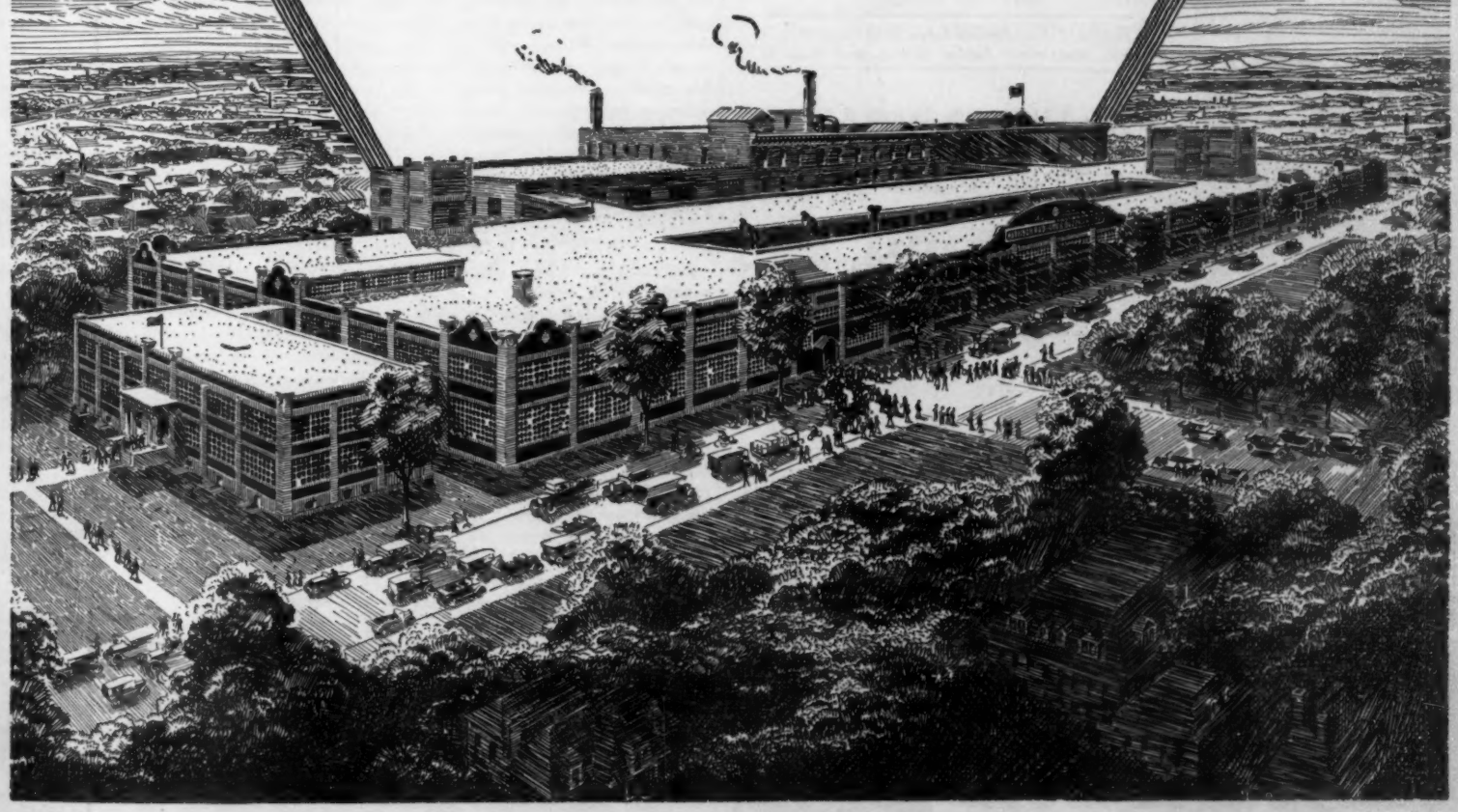
In describing this new plant of ours to you, we might dwell on the two-hundred thousand feet of floor space. We might elaborate on the machinery, much of it original with ourselves, all the most modern. We might explain the increased capacity of two thousand radiators a day. All this however would tell only the lesser part of the Harrison story.

RADIATORS FOR AIRPLANES AUTOMOBILES TRUCKS AND TRACTORS

To understand the *real spirit* that built the new Harrison plant you must understand *the Harrison idea of co-operation.* This includes quality and deliveries, of course; but also, and equally as important, it includes the human element—the desire and ability to work side by side with you in studying your individual radiator problems and helping you to solve them.

HARRISON RADIATOR CORPORATION
LOCKPORT, N. Y., U. S. A.

Incidentally, it is no small satisfaction to us that although this new plant was planned long before war even threatened, its realization comes when these improved facilities can play their part in helping America emerge victorious from the perils that threaten her freedom and institutions.



HARRISON

RADIATORS FOR AIRPLANES, AUTOMOBILES, TRUCKS AND TRACTORS

Lupton
Lupton Steel Sash
Pivoted Factory Type
Counterbalanced Type
Pond Continuous Sash
for sawtooths, monitors and side walls
Pond Operating Device
for long lines of sash
Lupton Rolled Steel Skylight
"INVESTMENT VALUE"

-to help win the war-

The Problem of Bigger Output

Many foundry and forge shop owners face the problem of increasing their output with minimum outlay on plant. Their buildings do not ventilate properly; full production in summer, or even in winter, is impossible, and the men will not stay on the job. Yet the steel shortage makes new buildings admissible only as a last resort.

The best solution, in many cases, is to remodel the old buildings to get more air and light. While that is a makeshift, marked improvement is often possible if the natural air movements are understood. The result is equivalent to an addition to plant, at a smaller first cost and without the subsequent labor cost.

No fixed formula can be applied to such cases; each must be studied separately. We gladly offer our specialized experience in daylighting and ventilating design to owners needing greater output for government work, and co-operate with your architect or engineer without charge.

Send cross section and elevations showing spacing and material of trusses, and floor plan showing location of important processes. We will indicate the most practicable reconstruction and the cost of sash required. We furnish the layout and sash —not complete designs or buildings.

Booklet, "Foundry and Forge Shop Ventilation," tells more about Lupton Service and Products

Lupton
INVESTMENT VALUE

DAVID LUPTON'S SONS COMPANY
Clearfield and Weikel Streets
PHILADELPHIA, PA.

For mass ventilation Pond CONTINUOUS SASH *In roofs and side walls*

Insure Against Car Theft

The car thief is always on the job. He takes a good look before he grabs the wheel. If he spots a POWERSTEEL AUTOWLOCK, he shies. That Yellow Strand Wire Rope and unpickable spring lock beat him. That's why you save 10% on theft insurance in some companies. At dealers, $2.25 east of the Rockies.

BASLINE AUTOWLINE saves in another way—in time, when you need a tow. It's also Yellow Strand Wire Rope, fitted with patented snaffle hooks. At dealers, $4.95 east of the Rockies.

Truck owners value the POWERSTEEL TRUCKLINE for its superstrength and unfailing service. Write for literature.

BRODERICK & BASCOM ROPE CO., ST. LOUIS NEW YORK
Manufacturers of celebrated Yellow Strand Wire Rope

POWERSTEEL AUTOWLOCK

The Photographic Eye and Memory of the Military Airman

(Concluded from page 61)

The first view of the group shows the cross roads in the town of Zonnebeke, where the Germans established a supply station. In the photograph can be seen the huge warehouses and the railroad tracks with trains. The British, through the use of aerial photographs, got the range of the cross roads and shelled the spot both day and night for two days, at the rate of 800 shells an hour, until it was obliterated as shown in the second view, where only the faint indications of the roads remain.

The center view was made from a plate exposed at a height of 15,000 feet over the town of St. Pol. The tiny dashes forming a long row in the main thoroughfare are the mules of a transport train carrying machine-gun ammunition to the front. Every house, backyard or garden, tree, vehicle and whatnot is clearly delineated in this view, proving forcibly the reconnaissance value of the aerial photograph.

Just what is a barrage fire is best explained by the fourth view, which was made by an aviator who was directing the British barrage fire depicted. This view demonstrates how the British gunners blocked off the second-line trench when attacking the front line, which appears in the lower portion of the illustration as a serpentine line. The British trench is slightly indicated in the lower right-hand corner. The idea of the barrage in this case is to cut off possibility of reinforcements from the German front line while it is being attacked and occupied by British infantrymen.

That the Hindenburg line—the vaunted defensive system of the Germans which was successfully pierced by the Allies last year—is more than a name is evident from the last illustration, which shows part of this famous series of German defenses in France. Incidentally, this photograph pays a tribute to the thoroughness with which the Germans organize their positions, especially at a time when they were mainly on the defensive through lack of numbers. The dark streak running through the upper left-hand corner is the first German line of barbed wire, while immediately back of this can be seen the second and third lines of barbed wire. At the right, plainly delineated, are the German trenches. The cross in the lower center of the view indicates machine-gun emplacements that have been carefully picked out by the pilot for bombardment by the heavy British artillery.

From the Trenches to Open Warfare

(Concluded from page 69)

Studying the Von Hutier attack in perspective, it seems that the main question is one of surprise. The element of time, too, is all-important. For if the defenders on the line attacked can hold sufficiently long, even at the cost of giving up say the first and second lines, the mass of maneuver now at the disposition of Foch, the Allied commander-in-chief, can be brought up. According to the best authority it requires about 70 hours to move up this mass, and in the meantime it is a question of how much the Germans can gain. Once the Allied reserves reach the scene of battle, no matter whether it is Von Hutier's method or not that is being employed by the Germans, the combat is soon stabilized as we have seen in the Somme offensive, in Flanders, and on the Marne.

We may still have Von Hutier to thank for a valuable suggestion. When the American Army in France attains its full size some time next summer, and when the Allies are provided with a preponderance of mobile artillery of the types shown in the accompanying illustrations, it will be the Allies' turn to breech the German line and exploit it to the utmost. Given overwhelming numbers of men and mobile artillery, and with an unexcelled transportation service through almost countless motor trucks, we should be able to breech the Hun line first and then pour through it in a manner which ought to make Von Hutier, to use a homely phrase, perfectly "green with envy."

Spraying Smoke Clouds Out of Sight

(Concluded from page 65)

box is from two-tenths to three-tenths of an inch of water; but with this device the vacuum varies from four-tenths to five-tenths, and thus the combustion is actually accelerated. This is an important point, particularly if we remember that a merchantship is liable to be chased by a submarine at a time when the fires may not be in good condition. The spray of cold water is supplied by a pump in the engine room at a pressure of 150 pounds per square inch.

Sir Alfred Yarrow states that the estimated cost of putting in this device is about one-half of one per cent of the total value of the vessel; and the time occupied in fitting it on board should not exceed one week, provided the necessary parts and plant, such as the pump, the ducts and the sprayers, are at hand when the ship makes fast at her wharf.

Here is a device which we commend to the consideration of the United States Shipping Board. It is not so much an engineering as a common-sense proposition, and it is the work of one of the most famous shipbuilders in the world, who, by the way, refuses to accept any remuneration in connection with the proposal, but makes a free gift of it to the British or any of the members of the Entente who may wish to make use of it.

Opening a New Link of New York's Vast Subway System

(Concluded from page 71)

subway. Access to the site was had through drifts that were run from the Grand Union plot under the existing subway. Pits were sunk from the floor of the old subway, and in some cases stoped up from the drift below, into which the columns were set up. The girders were to run parallel to the tracks of the existing subway and hence diagonally across the new tracks. Alongside the tracks trenches were cut in the floor and rock to receive the big girders. The girders varied in size from 26 to 48 feet in length. They were 72 inches deep, back to back of flange angles, and weighed from 7½ to 35 tons. So heavy were they that it was deemed inadvisable to attempt to lower them into place from the street. Had this been done it would have been necessary to interrupt street traffic, and cut upon the street decking and lowering the enormous girders into place. Instead of this, the girders were brought into position from beneath. Accordingly, a hole was cut from the drift of the new tunnel up to the level of the existing subway. This was cut on a slant so that it formed a ramp up which the girders could be skidded. After being brought up to the level of the existing subway the sheathing of the subway was cut out to permit of skidding the girder upon the express tracks. This work was done after one o'clock in the morning, when, for a period of five hours, express service is discontinued. Then, with the aid of a motorcar, the girder was hauled to the proper position and turned over on edge into the trench where it was properly positioned upon the columns that were to support it. After the girders were in place the new floor of the subway was built in, piece by piece; and in order to prevent the tracks from sagging at any point they were bound together by means of "H" girders whose flanges were fitted over the ends of the ties at the section where the work was being done. These "H" girders were fastened together by means of tie bolts, and they formed the track into a rigid bridge structure.

The placing of the steel to support the old subway tracks called for some very careful surveying. Traverses had to be run through the drifts and around the various tunnel openings to locate the positions for the columns. Despite the complexity of the work everything was most accurately calculated so that when it came to placing the final piece of steel it proved to fit perfectly and was driven home with a few taps of a heavy beam. No shimming and no reaming had to be done on the work. This is a tribute to the

careful and painstaking work of the engineers in charge.

By glancing at the accompanying drawing it will be noticed that the north bound local track does not pass under the existing subway but joins it just below Forty-first Street. The Diagonal Station is placed at a much lower grade than the present subway station, and were the north bound local to rise from the station to the level of the existing subway at the point the two intersect the grade would be too steep for its intended use.

The building line at Forty-first Street is close to the existing subway so that the new track cannot run off to the side and the only way in which connection can be made with the north bound local is to lower the grade of the existing tracks at this point. One of our photographs very clearly shows the difference in level at this junction.

The new local tracks pass under the old northbound local for a considerable distance, and when the Fourth or Park Avenue line is finally connected with the Lexington Avenue subway, the existing north bound local track will have to be cut away and connection can then be made with the new track at a point near Fortieth Street.

In our drawing the various levels are indicated by differences in shading. There is a broad mezzanine platform extending over the Diagonal Station and connected with the present subway station by means of a ramp. In this mezzanine platform there are a number of large elevators which run down to the Queensborough tunnel, formerly known as the Belmont tunnel, and prior to that as the Steinway tunnel.

The present subway platform will be extended so to bring the shuttle trains nearer the Diagonal Station. A large part of the Lexington Avenue subway is double-decked. The express tracks being on the lower level and the local tracks on the upper level, where they are more readily accessible to the street. A very interesting development is to be found at the 125th Street station. Here the subway performs a corkscrew twist which is very complex but which has a very good reason for its existence. As the subway is in two levels it has been planned to have downtown trains on the lower level and uptown trains on the upper level, the purpose of this being that, as most of the traffic is southbound in the morning, there will be no hardship in going down two flights of stairs to reach the lower level. In the evening, when the rush is north bound, tired passengers will be much relieved to find themselves on the upper level with only a single flight up to the street; and thus, while both express and local north bound trains are on the upper level here, we find further downtown that the expresses have been separated from the locals, with the express trains on the lower level and the locals on the upper level.

In the region above 125th Street there is another complication. Trains, after passing under the Harlem River, branch toward the west and the east, one line running under Jerome Avenue and the other under Westchester Avenue. Trains coming from these two branches down to 125th Street remain upon their own side of the track—those from the one branch on the west side and the others on the east side, whether they are locals or expresses. After passing the station they are routed on the express or local tracks. Northbound trains, on the other hand, are switched over after passing the 125th Street station according to the branch that they are to take. In order to avoid switching upon coming into a station and to allow for it after the station has been passed, a very complicated arrangement of tunnels is provided.

In a general survey of the new line one cannot but be impressed with the intelligence and foresight shown in planning this piece of New York's great subway system. At the same time the work stands out as one of the most notable undertakings in a city renowned for its big and daring engineering achievements.

Price Fixing Contracts on Patented Articles

(*Concluded from page 72*)

the facts a decision would be handed down which would enable an inventor to retain certain rights in connection with the resale of patented articles.

A brief statement as to the previous cases considered by the United States Supreme Court in which this question was involved will be of interest. In the case of Bobbs-Merrill Co. vs. Straus it was held that a copyright on a book did not give to the proprietor the right to vend the book and by a notice placed in the book fix a price below which it should not be resold by all those who might subsequently acquire title to the book.

In the case of Dr. Miles' Medical Co. vs. Park & Sons Co., it was held that under the general law the owner of movables could not sell the same and lawfully by contract fix a price at which the product should afterwards be sold, because to do so would be at one and the same time to sell or part with, and retain or hold.

In the case of Henry vs. A. B. Dick Co., it was held that the owner of patents on a machine had the right in selling one of the machines to make a contract with the purchaser requiring the latter to buy from the owners of the patents all materials essential for working the machine. At the time this case was decided there was one vacancy on the United States Supreme Court Bench and one member of the Court was absent. In the subsequent cases of Bauer vs. O'Donnell and Straus vs. Victor Talking Machine Co., rulings were made in conflict with the doctrine announced in Henry vs. Dick, which case was consequently overruled. The case of Bauer vs. O'Donnell held that the right of a patentee to impose a restraint on the price of future sales of a patented article was not within the monopoly conferred by the Patent Act.

In the case of Straus vs. Victor Talking Machine Co. it was held that it was necessary for the Court to consider the substance of things and to disregard mere forms of expression as to licenses, etc., the Court ruling that the contract in this case was obviously in substance a sale of the patented article with the reservation limiting the price at which the patented article might be resold. Applying these cases, the Court, in deciding the case of Boston Store vs. American Graphophone Co. *et al*, held that although a contract was prepared in the form of a license, there was nevertheless an actual sale of the patented article, and this being so the owners of the patent could not lawfully reserve by contract a part of the monopoly right to sell granted under the patent. The law on this question is now clear, for from the above cases it will be seen that the Courts will not look with favor on any form of contract which may be used with a view of reserving the right to fix the price on the resale of articles protected by patents.

Improving Fish by Smoking It

THE smoking of fish of good food quality that is not generally in demand on account of the flavor or on account of bones is advocated by the United States Bureau of Fisheries. As a result of the smoking process, the flavor and the texture are improved, and the bones may be removed easier than in the case of fried, baked, or broiled fish.

Smoked fish may be kept several weeks if protected from mold. This process should solve the problem of fishermen who find it difficult to dispose of their catch of "coarse" fish, except at the very lowest prices, as properly smoked fish commands a higher price. A small smokehouse for fish would also be a profitable investment for owners of fishponds and even for householders who are able to secure fresh fish at nominal prices.

The general method of smoking fish and the construction and operation of a small smokehouse that has proved satisfactory are described in a circular which will be supplied free on application to Division F, Bureau of Fisheries, Washington, D. C.

Why Doesn't Your Automatic Telephone Rust?

When the warm days come—and you are working your trusted Automatic overtime to keep up with the war time activities of your organization—why doesn't the base stand or transmitter rust?

When the acid from the perspiration of your hand works its way through the enamel down to the metal, why doesn't the steel corrode and shortly cause the enamel finish to flake away?

To forestall these conditions the Automatic Electric Company uses the Parker Process. The Parker Process prevents rust and thereby insures all users of the automatic Telephone a permanent finish—and a permanent service.

A Book on Rust-Proofing for Industrial Executives

No matter what you manufacture—if you use iron or steel in any way—you will find valuable information in the Parker Process book. This explains how the Parker Process is rapidly reducing the great toli rust takes annually from our steel supply—how it is being used on metal articles from motor trucks to typewriters—and how easily you can apply it to your own product without in any way interfering with your present production plans. For your copy address

In addition to the base stand and transmitter the Automatic Electric Company rust-proofs the cores, and armatures of all coils—as well as other small parts of exposed metal. This is the third year that the Parker Process has been used in the production of the Automatic Telephone.

PARKER RUST PROOF COMPANY *of* AMERICA

DETROIT, MICHIGAN, U. S. A.

PARKER PROCESS

RUST PROOFS IRON AND STEEL

Spies and Lies

German agents are everywhere, eager to gather scraps of news about our men, our ships, our munitions. It is still possible to get such information through to Germany, where thousands of these fragments—often individually harmless—are patiently pieced together into a whole which spells death to American soldiers and danger to American homes.

But while the enemy is most industrious in trying to collect information, and his systems elaborate, he is *not* superhuman—indeed he is often very stupid, and would fail to get what he wants were it not deliberately handed to him by the carelessness of loyal Americans.

Do not discuss in public, or with strangers, any news of troop and transport movements, of bits of gossip as to our military preparations, which come into your possession.

Do not permit your friends in service to tell you—or write you—"inside" facts about where they are, what they are doing and seeing.

Do not become a tool of the Hun by passing on the malicious, disheartening rumors which he so eagerly sows. Remember he asks no better service than to have you spread his lies of disasters to our soldiers and sailors, gross scandals in the Red Cross, cruelties, neglect and wholesale executions in our camps, drunkenness and vice in the Expeditionary Force, and other tales certain to disturb American patriots and to bring anxiety and grief to American parents.

And do not wait until you catch someone putting a bomb under a factory. Report the man who spreads pessimistic stories, divulges—or seeks—confidential military information, cries for peace, or belittles our efforts to win the war.

Send the names of such persons, even if they are in uniform, to the Department of Justice, Washington. Give all the details you can, with names of witnesses if possible—show the Hun that we can beat him at his own game of collecting scattered information and putting it to work. The fact that you made the report will not become public.

You are in contact with the enemy *today*, just as truly as if you faced him across No Man's Land. In your hands are two powerful weapons with which to meet him—discretion and vigilance. *Use them.*

COMMITTEE ON PUBLIC INFORMATION

8 JACKSON PLACE, WASHINGTON, D. C.

George Creel, Chairman
The Secretary of State
The Secretary of War
The Secretary of the Navy

Contributed through Division of Advertising — *United States Gov't Comm. on Public Information*

This space contributed for the Winning of the War by

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NEW BOOKS, ETC.

THE NEW YORK CHARITIES DIRECTORY. A Reference Book of Social Service in or Available for Greater New York. By Lina D. Miller. New York: Charity Organization Society, 1918. 8vo.; 518 pp. Price, $1.

Each successive issue of this annual sees an extension of its usefulness. The war has brought into being many additional agencies that come within the scope of the Directory, and these are grouped under "War Relief" and "War Service." For some years the publication has outgrown its original title and it no longer restricts its columns to purely charitable organizations; among other lists that exceed this limitation may be mentioned social welfare periodicals, ambulance service and foreign consuls. The coöperation of the listed societies and institutions has been obtained, so that the information may be regarded as accurate, authoritative and up to date. Art, education, agriculture, recreation, colonization and medicine, to name but a few of many activities, all contribute their share to the making of the Directory, which is really a sociological contribution of vast and varied interest. Its name index furnishes a key to those individuals who are prominent in the humanizing influences of the day, and its subject index and general alphabetical arrangement makes it easy to put the finger upon any item required without loss of time.

ADVERTISING AND SELLING PRACTICE. By John B. Opdycke. Chicago, New York and London: A. W. Shaw Company, 1918. 8vo.; 244 pp.; illustrated. Price, $1.25.

The field of advertising is now highly systematized, and certain principles are recognized and taught. The science and art of selling are so lucidly yet undogmatically set forth by Mr. Opdycke in this work that teachers and students might well adopt it as a standard text. Unlike most books on the subject, its primary aim is to start the adolescent aright; this does not mean, however, that the professional can afford to ignore it; the work serves the business office no less than the class room. The author's astute remarks as to the one-ness of literature and advertising, and the influences that each is exerting upon the other are both incontrovertible and enlightening. The expounded principles are followed by concrete exercises admirably adapted to bring out the powers of the student; advertising policies and methods are outlined and illustrated, valuable points and suggestions are reduced to chart form, and there is a long bibliography of works on advertising and selling from current lists of American and British publishers.

OLD-TIME SHIPS OF SALEM. Salem, Mass.: Essex Institute. 4to.; 70 pp.; illustrated. Price, $2.

The enterprise of old Salem furnished some thrilling chapters in our maritime history. The proverbial boldness of the Basque whaling captain was equalled if not surpassed by the indomitable pluck of the hardy sea-dogs who kept open the stormy paths of communication between Salem and "new and distant peoples living upon the shores of all parts of the known world." The old ships are gone never to return but fortunately the shipmasters of those days acquired the habit of perpetuating in water colors the vessels of which they were so proud. Many of these paintings, by well-known artists, are now in the Peabody Museum, and sixteen of them are reproduced in this portfolio, with numerous smaller reproductions of other famous ships, brigs and barks. The text gives their history and adventures, and the collection teems with interest for those who delight in the sea, in the wind-driven vessels that dared its stormiest moods, and in the romance of the early days of overseas commerce.

AMERICAN LUBRICANTS. From the Standpoint of the Consumer. By L. B. Lockhart, Consulting and Analytical Chemist, Easton, Pa.: The Chemical Publishing Company, 1918. 8vo.; 246 pp.; illustrated.

The function of lubricants is to intervene between the moving surfaces of machinery, thus substituting fluid friction for solid. Upon the suitability of the oil or grease, upon its viscosity and the quantities in which it is supplied, hangs the efficiency and life of the machinery. "American Lubricants" supplies such knowledge as will enable users of the internal combustion engine, the steam engine, and electrical installments to understand the viscosimeter and to acquire an intelligent understanding of specifications for greases, graphite, boiler compounds and cotton waste. Testing methods and analysis are adequately treated, there are special chapters on such subjects as the lubrication of steam railways, textile mills, and miscellaneous plants and machines, and the good judgment used in excluding irrelevant material has resulted in throwing into high relief the main facts and most important considerations.

EXTRACTS FROM MANUAL OF PHYSICAL TRAINING. As Issued by the War Department for use in the United States Army. New York: National Military Publishing Co. 16mo.; 207 pp.; illustrated. Price, 75 cents net.

These admirable methods of training include setting-up exercises, marching, the apparatus work of gymnastics, and athletics, with instructions in swimming, boxing and wrestling, and a lecture on bayonet fighting. The material of the volume is adapted from the regulations in force in the new armies, and is profusely illustrated. Such a system of exercise increases in the soldier those necessary attributes of general health and bodily vigor, of muscular strength and endurance, of self-reliance, and of smartness, activity and precision. A week's program is given to show the application of the various branches of physical training to the actual life of the men in camp. There are remedial exercises for common defects and weaknesses, and every movement is made absolutely plain to the reader. It is a work that might well be taken as a guide by any man who wishes to make himself efficient for the occupations of peace, no less than for the man who will soon be doing his part in making the world safe for such peaceful occupations.

THE LANGUAGE OF COLOR. By M. Luckiesh, Physicist, Nela Research Laboratory. New York: Dodd, Mead and Company, 1918. 8vo.; 294 pp. Price, $1.50 net.

Lest the title of this work suggest a fanciful compilation similar to the "language of flowers," it may be well to say that the author is a scientific investigator who, to quote from his own introduction "does not permit his imagination to carry him away from the base of facts without maintaining lines of communication." This, his latest work on the elusive subject of color, devotes some space to the question as to whether the paucity of color-names met with in ancient literatures indicates that our present ability to recognize several hundred thousands of shades is an evolutionary development of but a hundred generations. Color in literature, in ecclesiasticism, and in the theater is treated with a wealth of suggestion; the researches and theories of psychophysiology are concisely put before the reader, and there are chapters on harmony, color-practice and color-music. In conclusion, the author states his belief that the language of color may come to compare favorably that of music, when its rudiments shall have been learned and standardized, and he is inclined to speak hopefully of an art of mobile color largely independent of line and form.

MODERN PIANO TUNING AND ALLIED ARTS. By William Braid White, Technical Editor of the *Music Trade Review*. New York: Edward Lyman Bill, Inc., 1917. 8vo.; 349 pp.; illustrated. Price, $2.

In a work that should find instant favor with conscientious tuners, an accepted authority on musical technic develops the theory of equal temperament and constructs and expounds a method for the application of the theory to actual tuning work. Most manuals of this kind either wander into a maze of theory or sacrifice accuracy to simplicity; both errors are here avoided with a great measure of success. Novel hypotheses are indeed advanced, to the healthy enhancement of interest, but in such manner as to supplement rather than retard the acquisition of more practical knowledge. Not only tuners, but any student of acoustics or of music, will find the text absorbing and stimulating. Piano and player repairing are given several chapters; a short bibliography and a full index round out an excellent work.

FOSTER ON AUCTION. A Complete Exposition of the Latest Developments of Modern Auction. By R. F. Foster. New York: E. P. Dutton and Company. 8vo.; 360 pp.; illustrated. Price, $2 net.

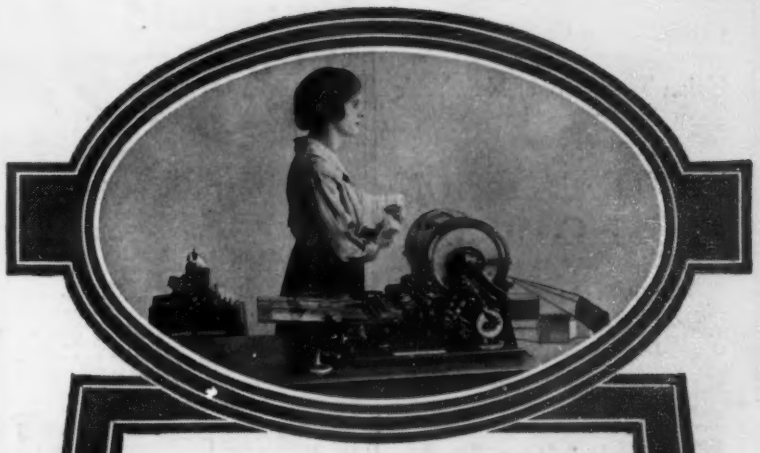
Mr. Foster holds that the older theories of bridge and whist as applied to auction are unsound, that auction is basically different from the earlier games, and that every hand in auction has a fixed value for attack or defense; it is a proper understanding of this value which he seeks to establish, to the end that the player may base his bids upon it and be absolutely sure of a certain return in tricks. The author is an original thinker and a copious writer on the subject of card games, and, although conservatives take exception to many of his findings, there can be no doubt that he has done much toward putting auction on a scientific basis.

THE EMPLOYMENT DEPARTMENT AND EMPLOYEE RELATIONS. By F. C. Henderschott and F. E. Weakly. Chicago: La Salle Extension University. 8vo.; 64 pp.; illustrated.

A subject that is at last receiving the attention that is its due is that of the selection and treatment of the employee, including training and promotions. Properly to carry out this important program requires the centralization of its activities under one head, that of the "employment manager." The well-qualified writers of this booklet deal with actual and typical conditions and methods, reproduce model forms of application and physical examination blanks, classify the sources of labor supply, and present a progressive scale of promotion based on general intelligence requirements. The work of the vocational laboratory—the most economical way of determining the individual's natural bent—is dealt with at length, and some pages are devoted to educational and welfare activities. The result is a richly suggestive and very helpful monograph.

NAVIGATION. A Short Course. By Frank Seymour Hastings, Instructor in Navigation, U.S.S. "Granite State." New York and London: D. Appleton and Company, 1917. 16mo.; 125 pp. Price, 75 cents net.

This little pocket manual imparts, in highly condensed form, all the knowledge necessary to enable a man to take his ship to any part of the world. This means that it covers chart sailing, the various times, compass error, dead reckoning, soundings, latitude, chronometer rating, and longitude by sun, stars and planets. The work is exceedingly timely, presents a sure and simple handling of problems, and comes to us with the endorsement of naval officers and experienced navigators. The scarcity of navigators in this time of emergency is disturbing to our necessary plans, and young men nautically inclined should welcome an authoritative manual that strips the subject to its bare essentials.



Mail-power! Salesmanship focused in an envelope—must help to release man-power for the days of the war. And better letters will help to make better business—now *as never before.* Your representative travels, not for three cents a mile, but a thousand miles and more for three cents—when Mimeographed. You don't know what the Mimeograph can do unless you have seen the *new* Mimeograph. It easily turns out five thousand *beautifully printed* letters an hour—at *smallest* cost. Diagrams, designs, forms, blanks, bulletins, tags, etc., at the same rate. The Mimeograph is doing great work for American business today. Let our representative show you how it will help in your selling—and other work. Or get booklet "A4" from A. B. Dick Company, Chicago—and New York.

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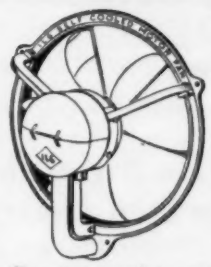

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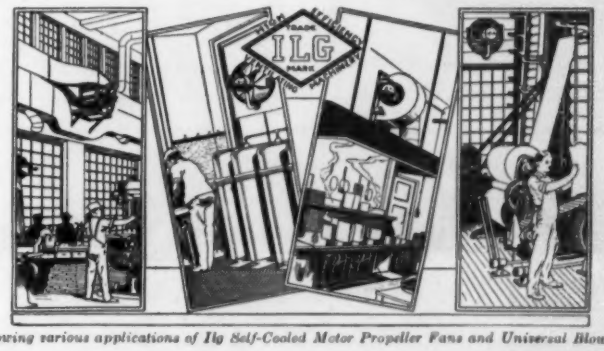
Can be used to *exhaust* heat, smoke, vapor, steam, acid fumes and can be used to *blow in* for *cooling*, drying, circulating.

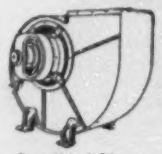


Showing various applications of Ilg Self-Cooled Motor Propeller Fans and Universal Blowers

We have solved ventilating, cooling and drying problems for all kinds of manufacturing plants.

Ilg Propeller Fans and Blowers are:

Low in power consumption
Quiet running
Durable
Covered by one guarantee as we build Fan and Motor



Centrifugal Blower direct connected type

We can make quick shipments in any quantity for any current or voltage.

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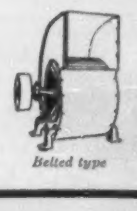

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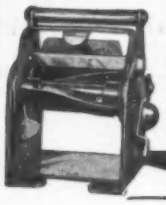

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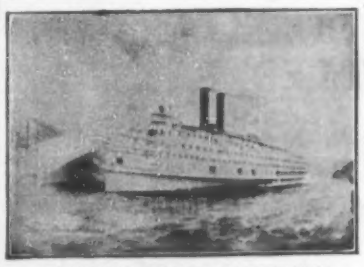

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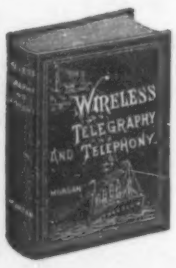

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(14287) E. L. R. asks: What is the centrifugal force in pounds per square inch of one pound one inch from the center of spin at 1,000 revolutions per minute? A. The centrifugal force of a revolving weight is given by the formula, $F = 1.2270\ W\ R\ n^2$. In this formula, F is the force in pounds; W is the weight in pounds; R is the radius in feet; n is the number of revolutions per second. If you substitute these numbers in the problem which you give, you will have no difficulty in finding the centrifugal force in pounds. The force is in pounds, not in pounds per square inch. This formula you will find in Kent s Mechanical Engineers Pocket Book, on page 521, 9th edition. Price $5. We shall be pleased to receive your order for a copy.

(14288) B. J. asks: A claims that a quantity of gold weighing a ton up here at the Artic circle will not weigh a ton at San Francisco, owing to centrifugal force being greater there than here. B. Claims it will weigh the same because the weight at the other end of the scale is also affected. Which is right? A. Anything weighed in the polar regions weighs more than if weighed on the Equator, if weighed by a spring balance, since the strength of the spring is not affected by gravity; but if weighed by a scale beam balance and weights the weight is the same in any part of the world, since the weights are affected by gravity to the same degree as the article which is weighed. Goods weighed in custom houses from foreign parts are always weighed by beam scales for this reason. B is quite right.

(14289) E. M. M. asks: Would you kindly tell me why it is that in marking the boiling point on a thermometer the thermometer is put into steam from boiling water instead of the water itself. Is the thermometer more apt to break in the water, or is the expansion of the glass greater, or is boiling water at a greater temperature than 100° C. under normal conditions? A. The reason for placing the thermometer in the steam from boiling water and not in the water itself when the thermometer is to be tested is that the temperature of the steam is always 212 degrees Fahr., if the barometer stands at 30 inches. The temperature of the water varies with its purity. If the water is pure the temperature of the water is the same as that of the steam. The steam is always pure. If the water contains any salt in solution the temperature of boiling is above 212 degrees. It is easier to obtain pure steam than it is pure water. Hence the practice of placing the thermometer bulb in the steam rather than in the boiling water. The expansion of the glass is the same for the same change of temperature whatever the source of the heat.

(14290) C. S. B. asks: I would like very much to know the inherent temperature of some few materials; namely, common gravel, common wood, such as oak or pine, ordinary bridge steel and lead. To help make it more clearly just what I want to know, you will notice a considerable difference in the temperature of the metal of the telephone on your desk and the wood desk itself, though they both are surrounded by the atmosphere of one temperature. Again, when we get out of bed in the morning the carpet on the floor is not uncomfortable to our feet, but when we step on the mosaic pavement in the bathroom we notice it is considerably colder than the carpet; however, they are both exposed to the atmosphere of the same temperature, so, therefore, I am led to believe that materials must possess what could properly be called inherent temperatures and that they do not necessarily assume the temperature of the atmosphere adjacent to them. I have found your handbook of untold value to me, but the one I have is some six years old, and wish that I could come in possession of a modern edition and I would appreciate it if you would send me one, billing me for same. A. What you term "Inherent Temperature" would seem to be the same as is known in science as "thermal conductivity," or the capacity to absorb heat, or to allow heat to pass into the material. The relative conductivity of the materials which you name is expressed by these numbers, oak, .58; sand, .24; lead, 83; hard steel, .60; soft steel, .111. These numbers are to be considered as approximate, and for ordinary temperatures. Different authorities would give numbers which differ somewhat from these. The reason why a piece of metal feels cold and a piece of wood at the same actual temperature feels warm is that the metal can take heat out of your hand more rapidly than the wood and so the hand feels cold from the loss of heat. If the wood and the metal were at the same temperature as your hand they would then feel the same when tested by the hand. Your hand is deceived by the difference in the withdrawal of heat from it, and you conclude that the metal is colder than the wood. A thermometer will not be so deceived and will indicate the real temperature of the various articles. It is a fact that articles which have been in the same place for a time will all be of the same temperature when tested by a thermometer.

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TWO years ago automobile dealers faced what seemed likely to become a serious affair—that of disposing of Used Cars, taken in exchange on sales of new cars. Manufacturers, also, were concerned. Some felt we even were approaching the "saturation point."

Today, used cars of high quality are eagerly welcomed by automobile dealers. The used car has become as necessary to the conduct of the automobile business as the new car —provided that the car is of high quality backed by reliable manufacture.

There are some 1916 models which—after two years of service—are selling for higher prices today than they sold for originally. These cars are Delco equipped.

A careful study of the re-sale value of cars, and the increase in re-sale values during the past year, shows that those carrying Delco electrical equipment are selling for higher prices than many others.

We do not claim that the increased re-sale value is due to the fact that these cars have Delco equipment. But we do know that the manufacturer who is willing to spend the increased amount of money necessary for Delco equipment has also been willing to put into his cars a quality of workmanship and materials that makes for a good, durable performance.

THE plain facts reiterate that the first cost is not the most important thing, and that "Quality is remembered long after price is forgotten."

The man who buys a Delco equipped car is not spending money, but making an investment—and the *interest* on his investment is represented by the increased re-sale value of his car.

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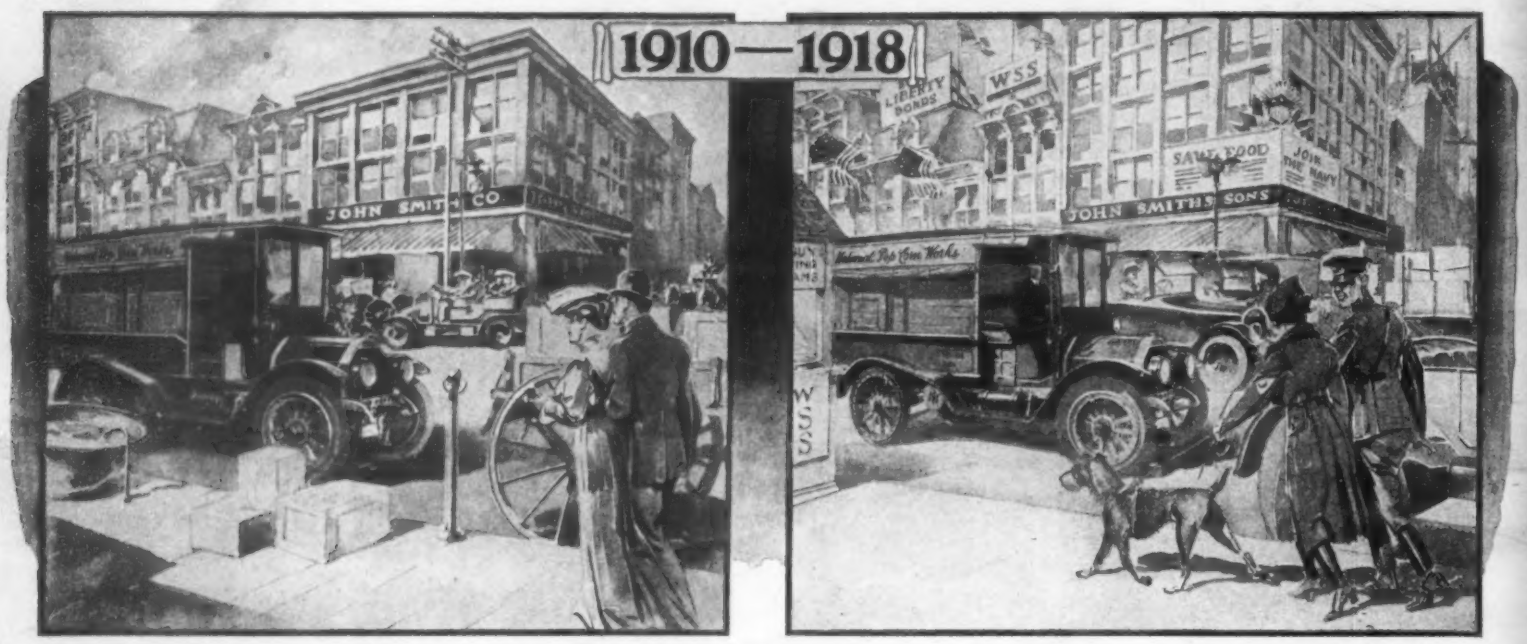

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Eight years spans practically all of the history of motor trucks. In that time, this first Federal has witnessed a complete revolution in haulage.

It has seen motor haulage practically supplant the horse and open the way to a broader commercial growth.

It has seen the motor truck come to the rescue in war-time when freight congestion swamped the over-burdened railroads.

It has seen the first small Federal factory grow to a mammoth plant and the name "Federal" on the radiator become a national institution in itself signifying sure, efficient haulage at lower costs.

The record of this first Federal's eight years of successful service differs from Federals following it only in length of service.

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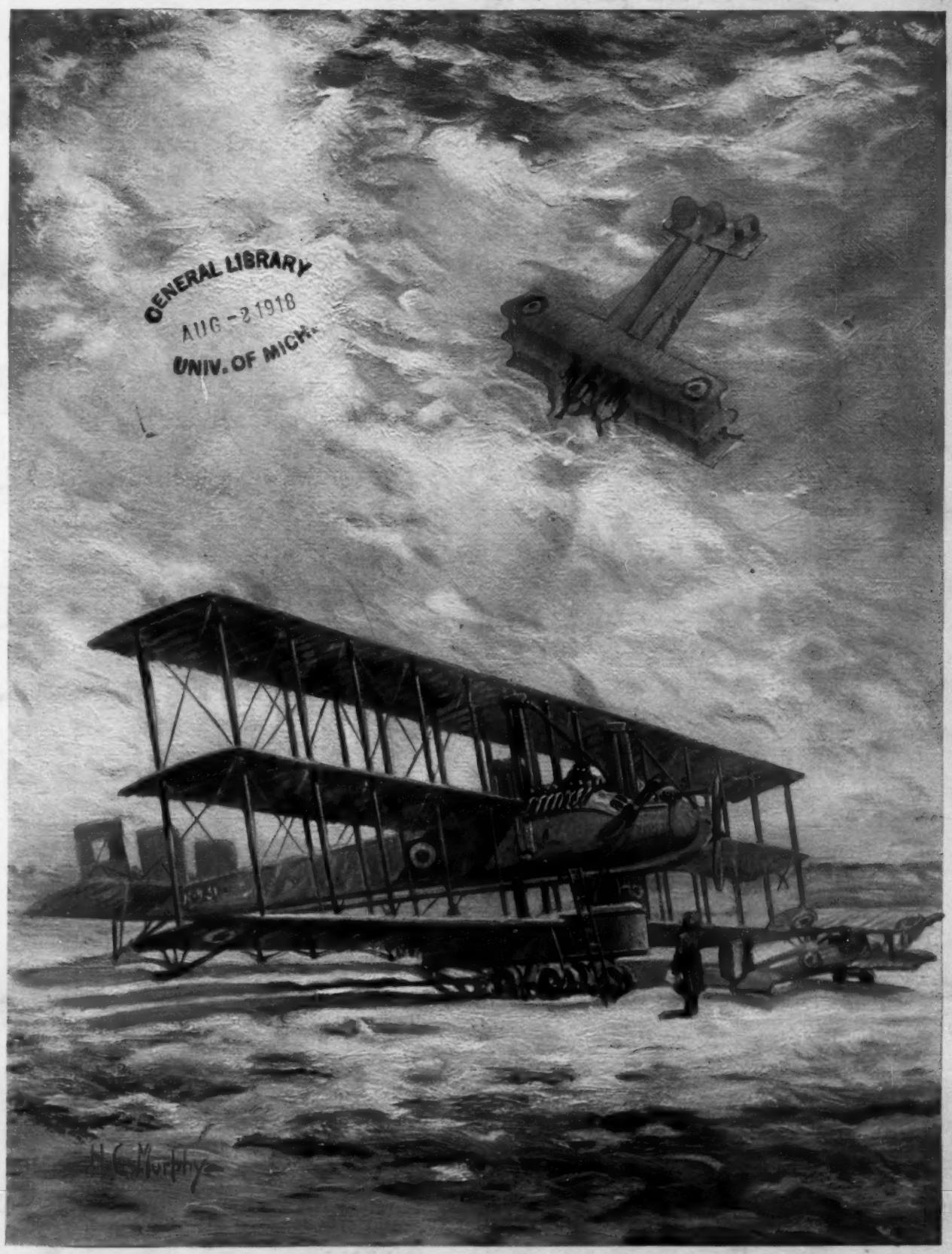

BATTLESHIPS AND DESTROYERS OF THE AIR: CAPRONI TRIPLANES AND A FAST ITALIAN SINGLE-SEATER PLANE [See page 86]

August 3, 1918

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

THE ROAD TO BERLIN BEGINS IN AMERICA

AS a truck manufacturer, in nation-wide contact with all phases of motor truck transportation, this company sees a grave menace to the American public through the lack of well-constructed roads.

With the industrial machinery of America harnessed for war and depending upon motor trucks for a constant flow of materials, the failure to maintain existing roads, or to build them of lasting construction, delaying the movement of war supplies, is a national peril equivalent to giving aid to the enemy.

War's ramifications reach every city and hamlet. The "peace road" of today may become a "war road" tomorrow. After the war it again becomes a "peace road" whose strength must be equal to a tremendous highway traffic. It is imperative, therefore, that we build permanent roads capable of standing heavy traffic and they must be built from state line to state line to connect all centers of production and population.

Railroads Cannot Carry the Load

War has added enormously to peace traffic. Highways must relieve the railroads and highways *cannot* unless they are built to endure heavy trucking.

Last winter, more factories would have shut down for lack of coal, large cities would have suffered from food famine, and war exports would have been retarded, if motor trucks had not been able to operate from country to city, from inland to seaboard. But, *all* of this assistance was *limited* by the scarcity of good roads.

No Use to Produce Unless You Can Transport

The transport arteries of the nation *must* be kept open. That is a war essential. The 400,000 motor trucks in this country will not suffice unless each renders the utmost service. Trucks must run faster; carry heavier loads and, wherever possible, return loads. They must consume less fuel; they must use fewer men; *they must keep going*—performances which are *limited* by road conditions.

"Work or Fight"

This applies to machinery even more than it does to men, because machinery multiplies men. A wide expansion of truck service on our highways would release armies of men who could be better employed.

Permanent Roads, not temporary repairs, are needed. We have two million miles of road and only one percent of them are permanently improved. Think of it!

As far as money, men and material can be had, road construction should proceed at top speed. What is done this summer will help to feed our people next winter and *keep industry going*.

THE WHITE COMPANY, *Cleveland*

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"Meanwhile, unfilled orders are piling up and it costs me fifty to sixty dollars to break in an untrained man. What is the matter?"

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Haphazard wage increases do not cure discontent. Many companies paying their men generously are still burdened with a labor turnover of 500% or even more.

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It is true that war has cut down the number of good cars that can be built. And yet in war-time a good car is almost indispensable to the efficient man of affairs.

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20,000 Twin Six owners know the Packard as a mode of travel—assurance of swift and safe transportation over any road.

Ask the man who owns one

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